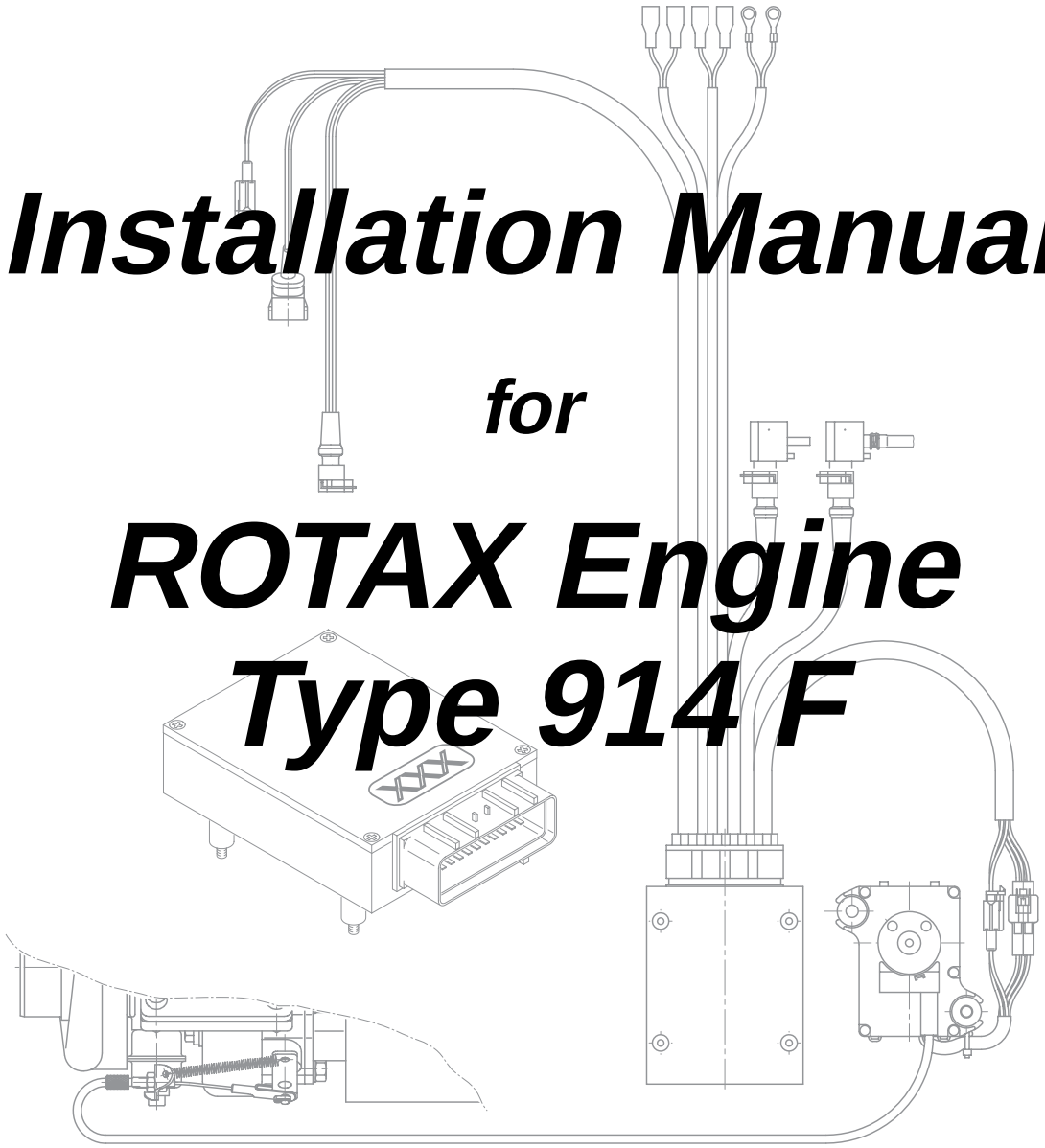
ROTAX®

AIRCRAFT ENGINES



# *Installation Manual*

## *for*

# *ROTAX Engine Type 914 F*

**⚠ WARNING**

Before starting with the engine installation, please, read the Installation Manual completely as it contains important safety-relevant information. Failure to do so may result in **personal injuries including death.**

**Edition: 0 of 1996 05 10**

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# 3) Preface

Congratulation on your decision to use a ROTAX aircraft engine.

Before starting with the engine installation, read this Installation Manual carefully. The Manual will provide you with basic information on correct engine installation, a requirement for safe engine operation.

If any passages of the Manual are not completely understood or in case of questions, please, contact an authorized Distribution- or Service Partner for ROTAX engines.

We wish you much pleasure and satisfaction flying your aircraft powered by this ROTAX engine.

## 3.1) Remarks

This Installation Manual is to acquaint the owner/user of this aircraft engine with basic installation instructions and safety information.

For more detailed information on operation, maintenance, safety- or flight, consult the documentation provided by the aircraft builder and dealer.

For further information on maintenance and spare part service contact the nearest BOMBARDIER-ROTAX distributor (see chapter of Service Partners).

## 3.2) Engine serial number

On all enquiries or spare parts orders, always indicate the engine serial number, as the manufacturer makes modifications to the engine for further development.

The engine serial number is on the top of the crankcase, magneto side.

# 4) Safety

Although the mere reading of these instructions will not eliminate a hazard, the understanding and application of the information herein will promote the proper installation and use of the engine.

The information and components-/system descriptions contained in this Installation Manual are correct at the time of publication. BOMBARDIER-ROTAX, however, maintains a policy of continuous improvement of its products without imposing upon itself any obligation to install them on its products previously manufactured.

BOMBARDIER-ROTAX reserves the right at any time to discontinue or change specifications, designs, features, models or equipment without incurring obligation.

The illustrations in this Installation Manual show the typical construction. They may not represent in full detail or the exact shape of the parts which have the same or similar function.

Specifications are given in the SI metric system with the USA equivalent in parenthesis. Where precise accuracy is not required, some conversions are rounded off for easier use.

## 4.1) Repeating symbols

This Manual uses the following symbols to emphasize particular information. These indications are important and must be respected.

▲ WARNING: Identifies an instruction which, if not followed, may cause serious injury including the possibility of death.

■ ATTENTION: Denotes an instruction which, if not followed, may severely damage the engine or other component.

◆ NOTE: Indicates supplementary information which may be needed to fully complete or understand an instruction.

## 4.2) Safety information

▲ WARNING: Only certified technicians (authorized by the local airworthiness authorities) and trained on this product are qualified to work on these engines.

▲ WARNING: Never fly the aircraft equipped with this engine at locations, airspeeds, altitudes, of other circumstances from which a successful no-power landing cannot be made, after sudden engine stoppage.
Aircraft equipped with this engine must only fly in DAYLIGHT VFR conditions.

➪ This engine is designed for possible application on aircraft used in VFR conditions which have the capability of controlled gliding without engine power.

➪ This engine is not suitable for acrobatics (inverted flight, etc.).

➪ This engine shall not be used on rotor wing aircraft (helicopters, gyrocopters, etc.) or any similar aircraft.

➪ It should be clearly understood that the choice, selection and use *of this* particular engine on any aircraft is at the sole discretion and responsibility of the aircraft manufacturer, assembler and owner/user.

➪ Due to the varying designs, equipment and types of aircraft, BOMBARDIER-ROTAX makes no warranty or representation on the suitability of its engine's use on any particular aircraft. Further, BOMBARDIER-ROTAX makes no warranty or representation of this engine's suitability with any other part, component or system which may be selected by the aircraft manufacturer, assembler or user for aircraft application.

➪ Whether you are a qualified pilot or a novice, complete knowledge of the aircraft, its controls and operation is mandatory before venturing solo. Flying any type of aircraft involves a certain amount of risk. Be informed and prepared for any situation or hazard associated with flying.

A recognized training program and continued education for piloting an aircraft is absolutely necessary for all aircraft pilots. Make sure you also obtain as much information as possible about your aircraft, its maintenance and operation from your dealer.

➪ You should be aware that any engine may seize or stall at any time. This could lead to a crash landing and possible severe injury or death. For this reason, we recommend strict compliance with the maintenance and operation and any additional information which may be given to you by your dealer.

- Select and use proper aircraft instrumentation. This instrumentation is not included with the BOMBARDIER-ROTAX engine package. Only approved instrumentation can be installed.
- Before flight, ensure all engine controls are operative. Make sure all controls can be easily reached in case of an emergency.
- Unless in a run up area, never run the engine with the propeller turning while on the ground. Do not operate engine if bystanders are close.
- To prevent unauthorized use, never leave the aircraft unattended with the engine running.
- Keep an engine log and respect engine and aircraft maintenance schedules. Keep the engine in top operating condition at all times. Do not operate any aircraft which is not properly maintained or has engine operating irregularities which have not been corrected. Since special tools and equipment may be required, engine servicing should only be performed by an authorized BOMBARDIER-ROTAX engine dealer or a qualified trained mechanic approved by the local airworthiness authority.
- To eliminate possible injury or damage, ensure that any loose equipment or tools are properly secured before starting the engine.
- When in storage protect the engine and fuel system from contamination and exposure.
- Certain areas, altitudes and conditions present greater risk than others. The engine may require carburetor recalibration or humidity or dust/sand preventative equipment, or additional maintenance may be required. Consult your aircraft dealer or manufacturer and obtain the necessary information, especially before flying in new areas.
- Never operate the engine and gearbox without sufficient quantities of lubricating oil.
- Periodically verify level of coolant.
- Never exceed maximum rated r.p.m. and allow the engine to cool at idle for several minutes before turning off the engine.
- Operating the engine at high speed at low throttle position, for example during descent, may increase engine and exhaust temperatures and cause critical overheating. Always compensate and match r.p.m. with throttle position.
- The engine should only be installed and placed into operation by persons familiar with the use of the engine and informed with regard to possible hazards.
- Never run the engine without a propeller as this will inevitably cause engine damage and present a hazard of explosion.
- Propeller and its attachment with a moment of inertia in excess of the specified value must not be used and releases engine manufacturer from any liability.
- Improper engine installation and use of unsuitable piping for fuel,- cooling,- and lubrication system releases engine manufacturer from any liability.
- Unauthorized modifications of engine or aircraft will automatically exclude any liability of the manufacturer for sequential damage.

- ➪ In addition to observing the instructions in our Manual, general safety and accident preventative measures, legal regulations and regulations of any aeronautical authority must be observed.
- ➪ Where differences exist between this Manual and regulations provided by any authority, the more stringent regulation should be applied.
- ➪ This engine may be equipped with an Airborne air pump. The safety warning accompanying the air pump must be given to the owner/operator of the aircraft into which the air pump is installed.

## 4.3) Instruction

Engines require instructions regarding their application, use, operation, maintenance and repair.

- ➪ Technical documentation and directions are useful and necessary complementary elements for personal instruction, but can by no means substitute theoretical and practical instructions.
- ➪ These instructions should cover explanation of the technical context, advice for operation, maintenance, use and operational safety of the engine.
- ➪ All technical directives relevant for safety are especially emphasized. Pass on safety instructions to other users, without fail.
- ➪ This engine must only be operated with accessories supplied, recommended and released by ROTAX. Modifications are only allowed after consent by the engine manufacturer.

■ ATTENTION: Spare parts must meet with the requirements defined by the engine manufacturer. This is only warranted by use of GENUINE ROTAX spare parts and/or accessories (see spare parts list).

They are available only at the authorized ROTAX Distribution- and Service partners.

The use of anything other than genuine ROTAX spare parts and/or accessories will render any warranty relating to this engine null and void (see Warranty Conditions).

▲ WARNING: Engine and gear box are delivered in "dry" conditions (without oil). Before putting engine in operation it must be filled with oil. Use only oil as specified (consult Operator‘s Manual).

◆ NOTE: For longer periods (longer than 2 months) of engine stop, preservation of engine is recommended (see chapter **engine preservation** in Operator‘s Manual).

▲ WARNING: Exclusively use tools and supplementary materials as listed in the spare parts list.

▲ WARNING: This Manual for engine installation is only part of the Technical Documentation and will be supplemented by the respective Operator‘s Manual, Maintenance Manual and Spare Parts List.

Pay attention to references to other documentation, found in various parts of this Manual.

## 4.4) Technical documentation

The information given in the

- ➪ Installation Manual
- ➪ Operator‘s Manual
- ➪ Maintenance Manual
- ➪ Overhaul Manual
- ➪ Spare parts list
- ➪ Technical bulletins
- ➪ Service Informations

are based on data and experience that are considered applicable for professionals under normal conditions.

The fast technical progress and variations of installation might render present laws and regulations inapplicable or inadequate.

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## 6) Table of amendments

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# 7) Description of design

## 7.1) Designation of type

Basic type

e.g. ROTAX 914 F2:

**F2**: with prop flange for fix pitch propeller

**F3**: with prop flange with drive of hydraulic governor for constant speed propeller

**F4**: with prop flange for fix pitch propeller, but prepared for retro-fit of hydraulic governor for constant speed prop

Optional extras to the above stated basic type:

◆ NOTE: Conversion of the types F2 / F4 to type F3 may be accomplished by the manufacturer (BOMBARDIER-ROTAX).

## 7.2) Standard engine design

- ❹ 4 stroke, 4 cyl. horizontally opposed, spark ignition engine with turbo charger, single central camshaft hydraulic tappets - push rods - OHV
- ❹ liquid cooled cylinder heads
- ❹ ram air cooled cylinders
- ❹ dry sump, forced lubrication
- ❹ dual ignition of breakerless, capacitor discharge design
- ❹ 2 constant depression carburetors and airbox
- ❹ 2 electric fuel pumps (12V DC)
- ❹ prop drive via integrated gear box with torsional shock absorber and overload clutch
- ❹ stainless steel exhaust system
- ❹ engine suspension frame
- ❹ expansion tank (coolant)
- ❹ electric starter
- ❹ integrated AC generator with external rectifier regulator (12V 250 W)
- ❹ oil tank
- ❹ external start relay
- ❹ hydraulic governor for constant speed prop: (**optional** extra) (on F3 only)
- ❹ external alternator (**optional** extra) (12V 40A DC)
- ❹ vacuum pump (**optional** extra) (feasible on F2 and F4 only)
- ❹ drive for rev-counter / hour-meter (**optional** extra)

## Auxiliary equipment

■ ATTENTION: Any equipment not included as part of the standard engine version and thus not a fix component of the engine is not in the volume of supply.

Components especially developed and tested for this engine are readily available at BOMBARDIER-ROTAX.

▲ WARNING: **This equipment has not been tested for safety and durability to the standards of aviation.** The user assumes all risks possibly arising by utilizing auxiliary equipment.

The furnishing of proof in accordance to the latest FAR or JAR has to be conducted by the aircraft builder.

- Intake filter
- Oil cooler
- Coolant radiator
- Flydat
- Mechanical rev counter
- Electric rev counter
- Hour-meter

## 7.3) Engine components, engine views, numbering of cylinders, definition of main axes

See illustration 2/3/4/5/6.

**PTO** power take off side

**MS** magneto side

**A** points of attachment for engine transport

⊕ centre of gravity

**P** zero reference point for all dimensions

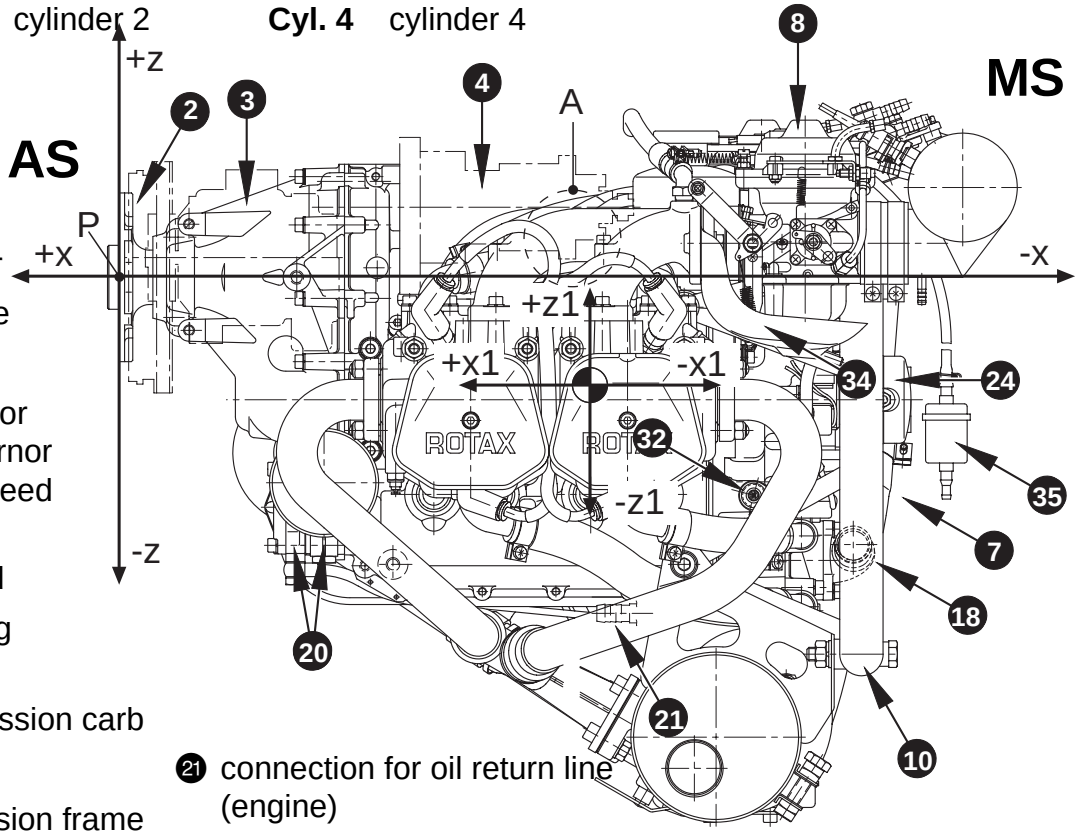
◆ NOTE: Allow ±1 mm on all stated dimensions as manufacturing tolerance

**x,y,z** axes for system of coordinates

**Cyl. 1** cylinder 1 **Cyl. 3** cylinder 3

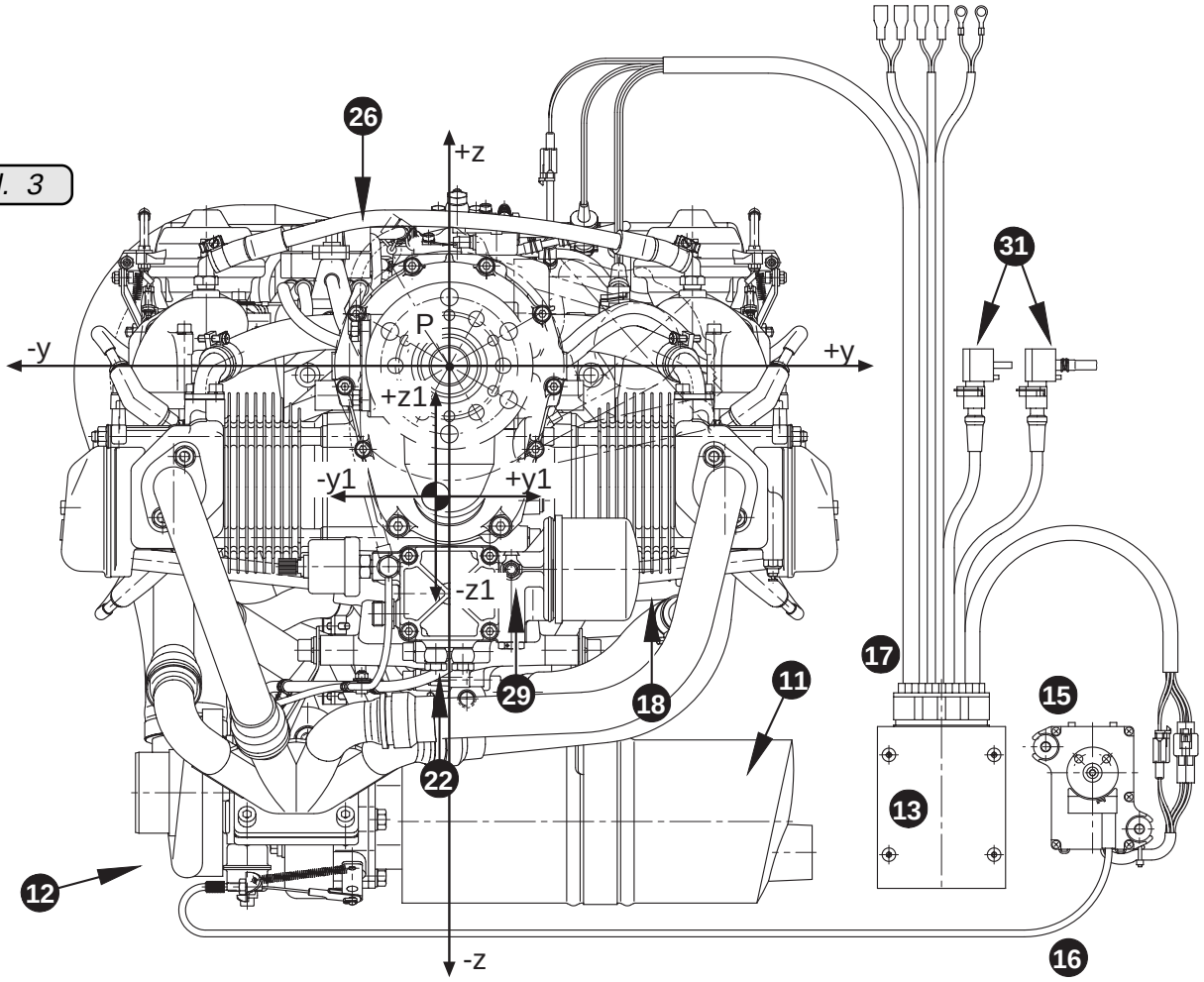
**Cyl. 2** cylinder 2 **Cyl. 4** cylinder 4

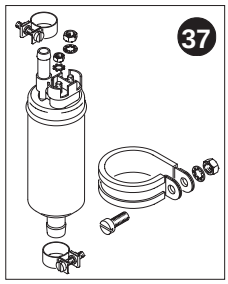
*Ill. 2*



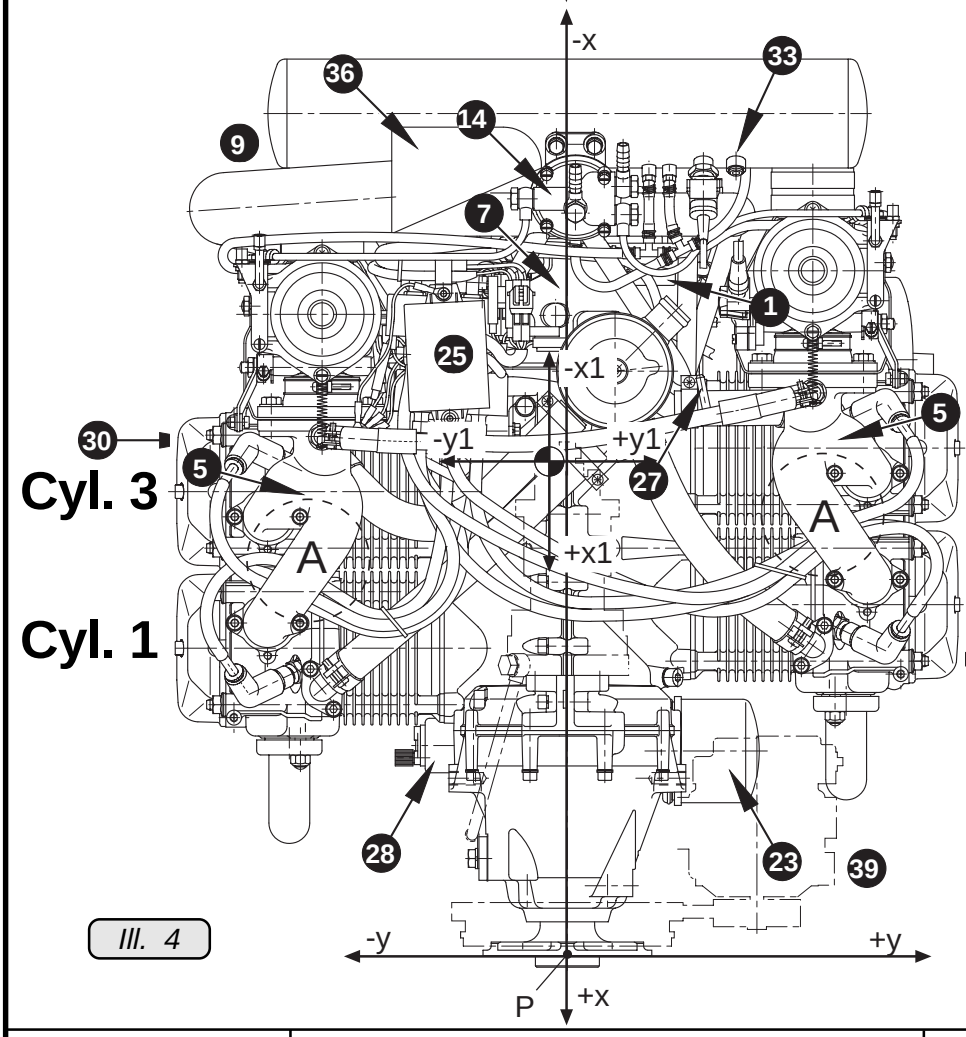

1. engine number
2. propeller flange
3. propeller gear
4. vacuum pump or hydraulic governor for constant speed propeller
5. intake manifold
6. ignition housing
7. ignition cover
8. constant depression carb
9. airbox
10. engine suspension frame
11. stainless steel exhaust system
12. turbocharger
13. turbo control unit (TCU)
14. fuel pressure control
15. servo motor
16. servo cable
17. cable assembly
18. coolant pump
19. expansion tank
20. 2 separate oil pumps
21. connection for oil return line (engine)
22. connection for oil return line (turbo)
23. oil filter
24. electric starter
25. electronic modules for ignition
26. compensation tube
27. connection for manifold pressure
28. sensor for oil pressure
29. sensor for oil temperature
30. sensor for cylinder head temperature
31. 2x pressure sensor
32. connection for mechanical rev-counter
33. connection for additional temperature sensor (airbox)
34. drip tray
35. water trap
36. three way solenoid valve
37. 2x electric fuel pump
38. oil tank
39. external alternator

*Ill. 3*

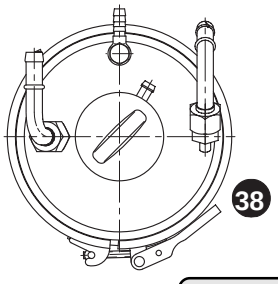



*Ill. 5*




*Ill. 4*




*Ill. 6*

| Modification-No. | Reference | Install | Date | Page |
|---|---|---|---|---|
| - 0 - | | 914 F | 1996 05 10 | 19 |

# 8) Technical data

To maintain clarity, only data relevant for engine installation and operation will be stated in the Manual.

◆ NOTE: Connecting dimensions, filling capacities, drive and reduction ratios, electric output etc. can be found in the respective chapter of engine installation.

## 8.1) Operating limits

1. **Engine speed**
   Take-off speed: ..... 5800 r.p.m. (5 min.)
   max. continuous speed: ..... 5500 r.p.m.
   idle speed: around 1400 r.p.m.

2. **Manifold pressure:**
   Take off performance ..... 1300 hPa (38,4 in.HG)
   maximum continuous performance ..... 1150 hPa (34,0 in.HG)

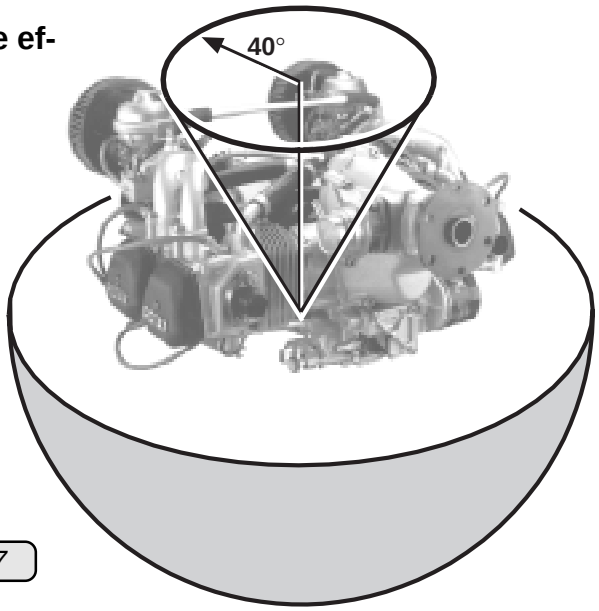
3. **Acceleration:**
   Time limit for engine operation at weightless condition and with negative gravity acceleration: ..... max. 5 sec at max. -5 g

4. **Critical flight level**
   Take off performance ..... to max. 2450 m (8000 ft) ASL
   maximum continuous performance ..... to max. 4500 m (16000 ft) ASL

■ ATTENTION: Up to the critical flight level the stated respective performance is available.

5. **Oil pressure:** ..... see chapter 13.2
6. **Oil temperature:** ..... see chapter 13.2
7. **Cyl. head temperature:** ..... see chapter 12.2
8. **Exhaust gas temperature:** ..... see chapter 11.1
9. **Airbox temperature:** ..... see chapter 16.1
10. **Range of starting temperature:**
    max. ..... 50° C (122° F)
    min. ..... -25° C (-13° F)
11. **Fuel pressure:** see chapter 14.2.
12. **Banking of plane deviation from the effective vertical:**
    See ill. 7.
    max. ..... 40°

    ◆ NOTE:
    Up to this inclination the dry sump lubrication system warrants adequate lubrication in every flight situation.




*Ill. 7*

## 8.2) Installation dimensions (all dimensions in mm)

See illustration 2/3/4.

| | Standard engine version | | |
|---|---|---|---|
| | pos. (+) | neg. (-) | total Σ |
| max. dimension in x-axis | 8,5 | -656,6 | 665,1 |
| max. dimension in y-axis | 288 | -288 | 576,0 |
| max. dimension in z-axis | 220 | -311 | 531,0 |

◆ NOTE: Dimensions to point of reference (P). See ill. 2/3/4.

## 8.3) Weights

Weight of engine defined to the following conditions:

➪ **Engine dry** from serial production with external alternator, but without fuel pumps (see chapter description of design)

Engine weight .....Version F2 and F4: ..... 74,7 kg (164 lb)
Version F3: ..... 77,4 kg (170 lb)

Weight of.....external generator assy.: ..... 3,0 kg (6,6 lb)
vacuum pump assy. ..... 0,8 kg (1,76 lb)
hydraulic governor assy. ..... 2,7 kg (6 lb)

## 8.4) Centre of gravity of engine and standard equipment

See illustration 2/3/4.

| | engine from serial production F3 | external alternator | hydraulic governor | vacuum pump |
|---|---|---|---|---|
| centre of gravity in x-axis | -327 | -100 | -276 | -255 |
| centre of gravity in y-axis | -9 | 139 | 0 | 0 |
| centre of gravity in z-axis | -102 | 6 | 56 | 56 |

◆ NOTE: Dimensions to point of reference (P). See ill. 2/3/4.

## 8.5) Moments of inertia in kg cm²

See illustration 2/3/4.

| | engine version F2 / F4 | engine version F3 |
|---|---|---|
| moment of inertia around axis x1 - x1 | 20 470 | 21 210 |
| moment of inertia around axis y1 - y2 | 24 560 | 25 450 |
| moment of inertia around axis z1 - z3 | 26 520 | 27 480 |

# 9) Preparations for engine installation

■ ATTENTION: The stated directives are measures to pay attention to at engine installation to prevent any accidents and engine damage.

## 9.1) Transport

The engine to be lifted by two hooks or straps around the middle of the intake manifolds.

See chapter engine views, numbering of cylinders and definition of main axes.

## 9.2) State of delivery

The engine is attached with 4 Allen screws M10x20 to steel angles anchored on a timber plate.

## 9.3) Engine preservation

The engine is preserved at ROTAX thus warranting proper protection against corrosion for at least **12** month after date of delivery from BOMBARDIER-ROTAX.

This warranty is subject to the following conditions:

- ➪ the engine has to be stored in the packing as supplied by ROTAX.
- ➪ the covers on various openings must not be removed (see chapter of protective covering)
- ➪ engine has to be stored in a suitable place.

If the engine is stored for a period longer than 12 month the following tasks have to be performed every six months:

- ➪ remove the 3 Allen screws M6x16 ❶ along with washer ❷ and lock washer ❸ and take off ignition cover ❹.

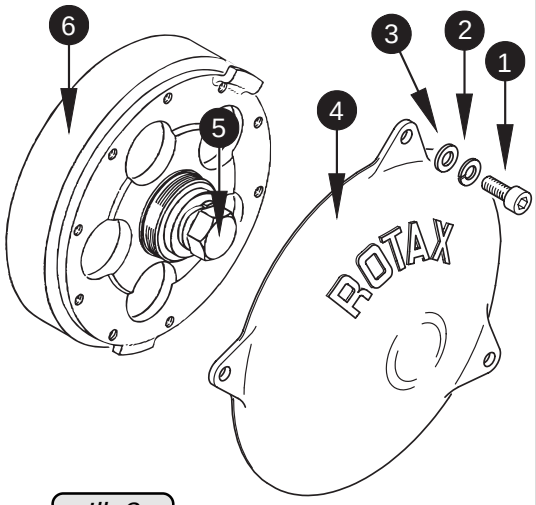
  Crank the engine by hand on attachment screw ❹ of flywheel ❻ 3 complete turns anticlockwise (viewed from Magneto side).

  Refit ignition cover in reversed sequence. Tighten the 3 Allen screws to 10 Nm (90 in. lb).

- ➪ inspect for corrosion (e.g. prop shaft). At detection of corrosion, send the engine to an authorized overhauler without delay.

▲ WARNING: The engine must not be put into service.

- ➪ repack engine into original packaging and seal properly.




*Ill. 8*

▲ WARNING: The maximum storage period is limited to 24 month!

Preservation for periods of longer than 24 months is only possible after a written permission of BOMBARDIER-ROTAX. Should the situation arise send engine for inspection to ROTAX.

◆ NOTE: No trouble to put engine back into operation after preservation.

## 9.4) Protective covering

All openings are protected against ingress of contamination and dampness. It is recommended not to remove these plugs until installation of the specific feed line.

◆ NOTE: If the engine will be sent to the manufacturer or distributor reuse transport equipment and replug openings.

List of protective covering:

- exhaust socket: ..... 1x cone plug
- Air intake socket on turbo: ..... 1x cover
- connection for manifold pressure: ..... 1x cap
- fuel pressure control (in-and outlet): ..... 1x each cap
- oil supply and oil discharge: ..... 1x each cap
- oil return (turbo): ..... 1x cap
- supply and discharge of coolant: ..... 1x each cone plug
- propshaft on version F3: ..... 1x disk plug

▲ WARNING: Protective covering to be utilized for transport and at engine installation only. Before engine operation remove these protections.

## 10) Engine suspension and position

■ ATTENTION: At installation of engine be aware of engine weight and assure careful handling.

The engine suspension is determined essentially by the aircraft design. Eight attachment points are provided on the engine (4 on engine and 4 on engine frame).

The engine will be supplied with a well tried and certified suspension frame for attachment on the fire proof bulk head. The exhaust system and the turbo charger are supported on this frame too. The installation into the aircraft is as generally practised by captive rubber mounts which ensure also to balance out vibrations and sound from engine to aircraft frame.

▲ WARNING: If the engine suspension frame supplied by ROTAX is not used or if modified, certification to the latest requirements such as FAR or JAR has to be conducted by the aircraft builder.

Furthermore a suitable suspension for turbo charger and exhaust system has to be developed. **Since these components weigh approx. 6 kg (13 lbs), this suspension has to be carefully designed and tested.** Certification to the latest requirements such as FAR or JAR has to be conducted by the aircraft builder.

▲ WARNING: The hex. hd. screws M10x60 ❶ on the attachment points R2 and L2 are only used for transport securing but must never be utilized for engine suspension. See ill. 9.

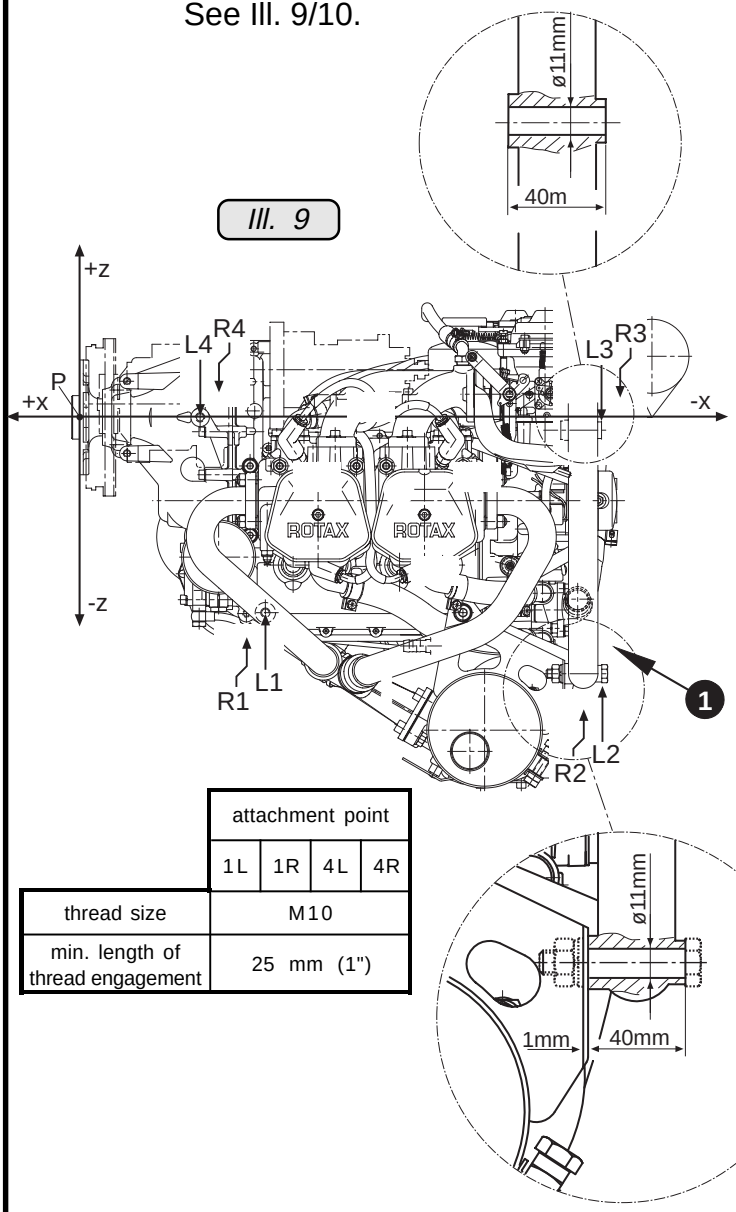
Therefore it is recommended to use the ROTAX engine suspension frame and the 4 stated attachment points R2, L2, R3 and L3 .

▲ WARNING: At least 4 of the eight anchorage points must be used in a side symmetrical pattern of the left (L) and right (R) side.

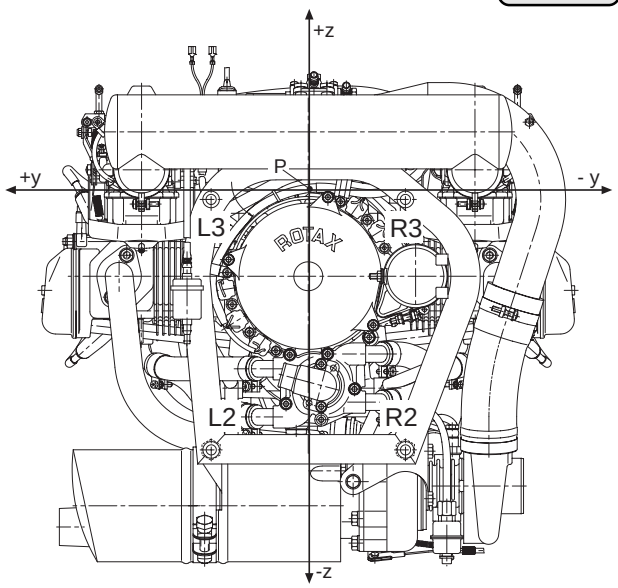
## 10.1) Definition of attachment points

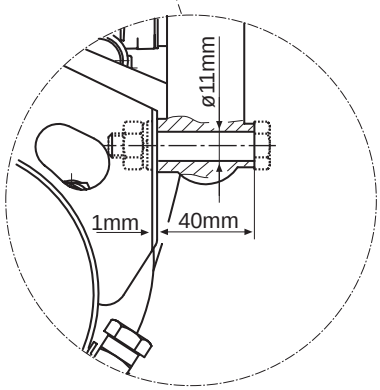
See Ill. 9/10.

*Ill. 9*




*Ill. 10*




| | attachment point | | | |
|---|---|---|---|---|
| | 1L | 1R | 4L | 4R |
| thread size | M10 | | | |
| min. length of thread engagement | 25 mm (1") | | | |

| attachment point | Axes | | |
|---|---|---|---|
| | x axis | y axis | z axis |
| L1 | -200,8 | -71,0 | -211,0 |
| R1 | -200,8 | 71,0 | -211,0 |
| L2 | -562,0 | 105,0 | -277,0 |
| R2 | -562,0 | -105,0 | -277,0 |
| L3 | -562,0 | 105,0 | -7,0 |
| R3 | -562,0 | -105,0 | -7,0 |
| L4 | -130,3 | -71,0 | 0,0 |
| R4 | -130,3 | 71,0 | 0,0 |

▲ WARNING: The engine suspension to be designed by the aircraft or fuselage builder such that it will carry safely the maximum occurring operational loads without exceeding the max. allowable-forces and moments on the engine attachment points.

| | attachment point | | | |
|---|---|---|---|---|
| | 1L | 1R | 4L | 4R |
| max. allowable forces (limit load) in (N) in x, y and z axis | 5000 | | 1900 | |
| max. allowable bending moment (limit load) in (Nm) in x, y and z axis | 77 | | 39 | |

| | attachment point | | | |
|---|---|---|---|---|
| | 2L | 2R | 3L | 3R |
| max. allowable forces (limit load) in (N) in x axis | 5 000 | | | |
| in y axis | 2 000 | | | |
| in z axis | 3 000 | | | |
| max. allowable bending moment (limit load) in (Nm) in x, y and z axis | 100 | | | |

▲ WARNING: Tighten all engine suspension screws as specified by the aircraft builder.

## 10.2) Permissible fitting positions

See Ill. 11/12/13.

To simplify the matter, reference is made only to the 2 engine attachment points R1, L1 and the 2 turbo charger attachment points R(T)2 and L(T)2.

Location of the 2 turbo charger attachment points R(T)2 und L(T)2.

◆ NOTE: All dimensions to point of reference (P) and the system of coordinates remain unchanged.

| | Axes | | |
|---|---|---|---|
| attachment point | x axis | y axis | z axis |
| L(T)2 | -414,3 | 71,0 | -211,0 |
| R(T)2 | -414,3 | -71,0 | -211,0 |

**The following details of engine position are with reference to aircraft on ground, ready for take off.**

➪ engine suitable for propeller in tractor or pusher arrangement,

➪ propeller shaft above cylinders. See ill. 2.

▲ WARNING: For upside down installation of the engine, the lubrication system, fuel system and the cooling system are unsuitable!

**<u>Longitudinal axis:</u>**

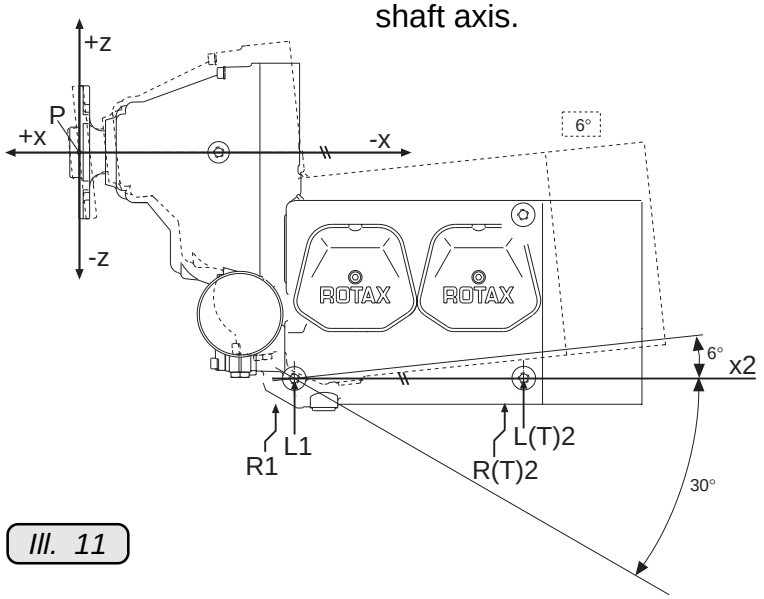
➪ The centre of the attachment points L1 and L(T)2 must be on axis x2 parallel to the x axis.

**Allowable pitch deviation of parallelism of axes:**

max. 6° counter-clockwise, **on ground**
max. 10° counter-clockwise, **in operation**
max. 30° clockwise (see ill. 11)

▲ WARNING: On installations with fuel tank located above carburetor level combined with badly closing carb float valve, fuel could pass into cylinders at more than 6° decline of propeller shaft axis after longer periods of downtime. See FAR, § 33.17.

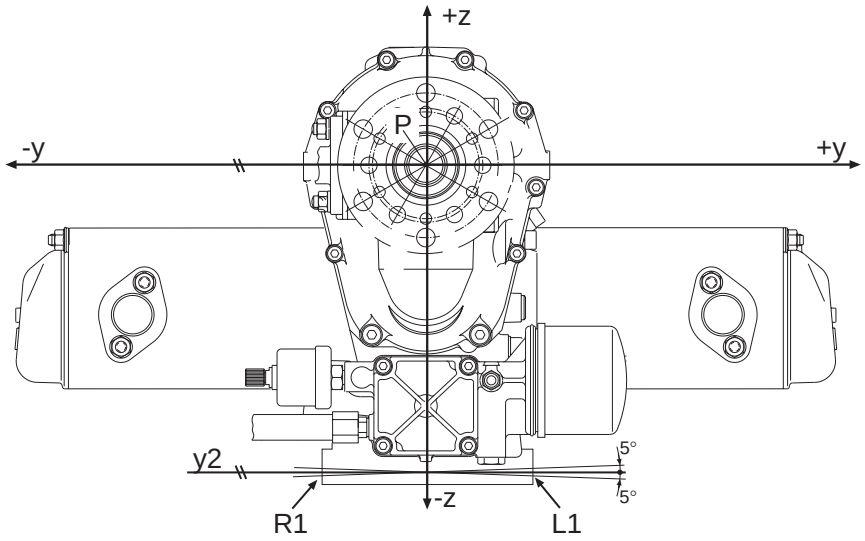
To prevent a possible hydraulic shock at engine start, ensure proper closing of float valves. If in doubt, park the aircraft with rising propeller shaft axis.




*Ill. 11*

**Propeller axis:**

➪ The centres of attachment points L1 und R1 must be on an axis y2 parallel to y-axis.

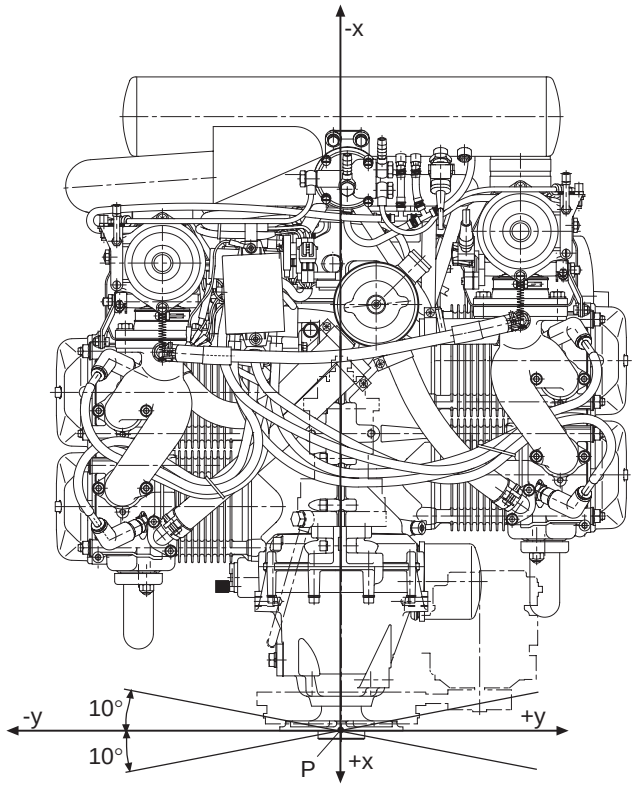



*Ill. 12*

**Tolerated roll deviation of parallelism:** ..... ± 5°. (see ill. 12)

**Vertical axis:**

➪ y-axis must be square to the longitudinal axis of the aircraft.



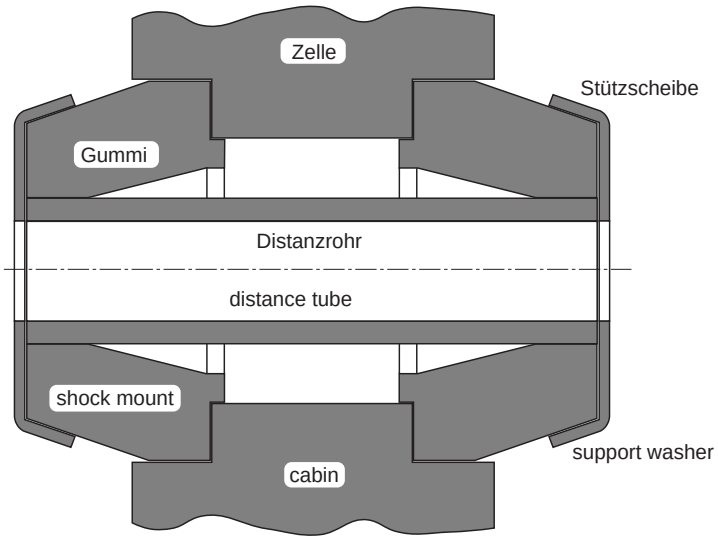

*Ill. 13*

**Yaw tolerance:** ± 10° (see ill. 13)

## 10.3) General directives for engine suspension

Rubber mounts to be used between engine and aircraft frame to neutralize vibrations.

Damping elements as generally used in the aircraft industry (e.g. LORD) are suitable. See ill. 14.




*Ill. 14*

◆ NOTE:
The illustration shows rubber mount Lord 33608-1 resp. 33608-2.

▲ WARNING:
All elements to balance out vibrations have to be of captive design.

◆ NOTE: With suspension on the 4 top lugs 3L, 3R, 4L and 4R only, the tilting moment due to the pull of the propeller will be avoided while, if attached on the bottom lugs only, the moment of tilting has to be taken care of accordingly.

▲ WARNING: The rubber mounts to neutralize vibrations and all the engine suspension components not in the supply volume must be ground run tested to the specified loads and for vibration behaviour. Certification to the latest requirements such as FAR or JAR has to be conducted by the aircraft builder.

◆ NOTE: The engine suspension has to be designed to prevent any excessive engine movement and to minimize noise emission and vibration on air frame side.

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## 11) Exhaust system

See ill. 15.

The complete exhaust system is in the volume of supply and is certified together with the engine.

▲ WARNING: If the ROTAX exhaust system is not employed or if modified, certification to the latest requirements such as FAR or JAR has to be conducted by the aircraft builder.

Modifications are permissible only if agreed with by BOMBARDIER-ROTAX.

◆ NOTE: As an exception, the exhaust end pipe can be modified to the following requirements:

➪ Mean bending radius of an exhaust bend: min. 40 mm (1,57 in.)

➪ Exhaust bend, inside diameter: min. 38 mm (1,50 in.)

➪ Medium tube length: max. 500 mm (20 in.)

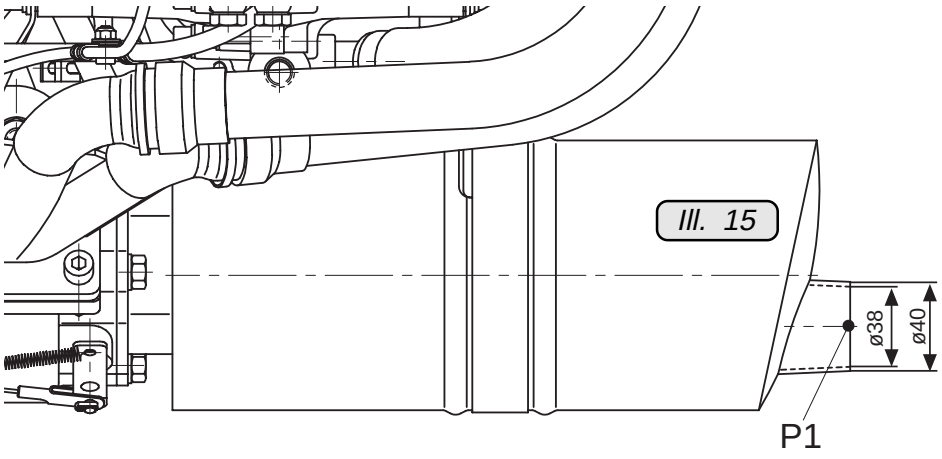
■ ATTENTION: At a medium tube length of 250 mm (10 in.) and more, the end pipe has to be supported additionally.

Material of the exhaust system: X 15CrNiSi 20 (DIN 1.4828)

**Location of the exhaust end pipe (P1)**

See ill. 15.

| | Axes | | |
|---|---|---|---|
| end pipe **P1** | x axis | y axis | z axis |
| | -420,0 | -270,0 | -371,0 |




*Ill. 15*

■ ATTENTION: Always fit heat shields near carburetors or as required.

Because of the high temperatures occurring, provide suitable protection against unintentional contact.

## 11.1) Operating limits

**Exhaust gas temperature:**

| | | |
|---|---|---|
| max. ..... | 950° C | (1740 ° F) |
| normal ..... | 900° C | (1650 ° F) |

Reading taken approx. 70 mm ( 2,75 in.) after exhaust flange.

# 12) Cooling system

## 12.1) Description of the system

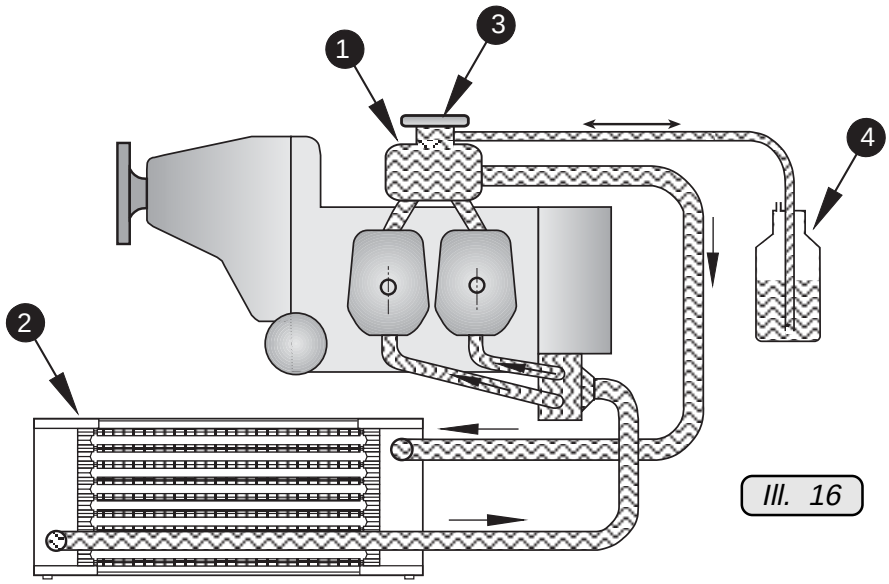
See ill. 16.

The cooling system of the ROTAX 914 F is designed for liquid cooling of the cylinder heads and ram-air cooling of the cylinders.

The cooling system of the cylinder heads is a **closed** circuit with an expansion tank.

The coolant flow is forced by a water pump, driven from the camshaft, from the radiator to the cylinder heads. From the top of the cylinder heads the coolant passes on to the expansion tank ❶. Since the standard location of the radiator ❷ is below engine level, the expansion tank located on top of the engine allows for coolant expansion.

The expansion tank is closed by a pressure cap ❸ (with excess pressure valve and return valve). At temperature rise of the coolant the excess pressure valve opens and the coolant will flow via a hose at atmospheric pressure to the transparent overflow bottle ❹. When cooling down, the coolant will be sucked back into the cooling circuit.




*Ill. 16*

The shape, size and location of one or more radiators depend mainly on the space available.

No provision is made for attachment of the radiator(s) on the engine.

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## 12.2) Operating Limits

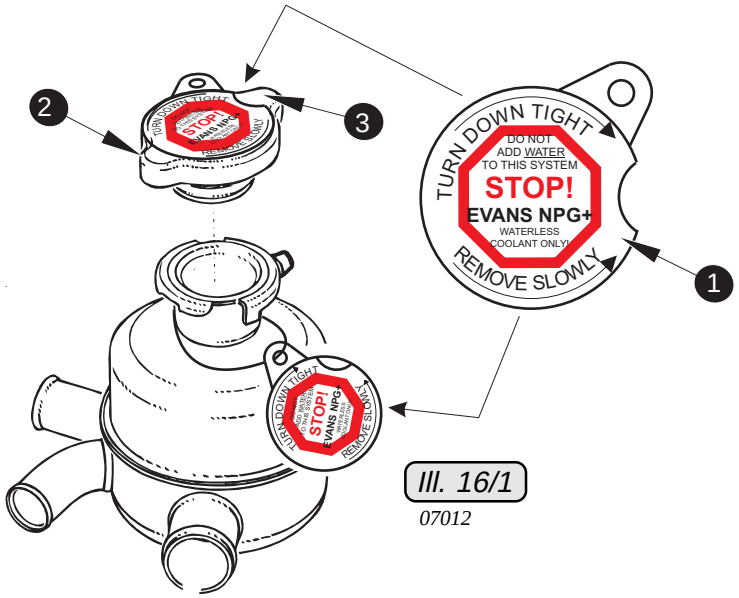
The operating limits (max. permissible cylinder head temperature) are dependent on the engine design but also essentially on the coolant used.

The hottest measuring point (cylinder 2 or 3) is to be specified by testing. For this purpose, see section 7.3 Engine Views. This is dependent on the installation (pulling or pushing propeller design).

The coolant to be used is defined clearly in the Operators Manual. Depending on the installation conditions, conventional coolants can also be used. The provision of proof about the max. reachable cylinder head temperature and thus the coolant to be used is the responsibility of the airplane manufacturer in regard to 12.2.1 and 12.2.2

■ CAUTION: The coolant to be used and its concentration is to be communicated in written form to the owner.

◆ NOTE: From ROTAX® a warning sticker is to be delivered for the water-free coolant which is mounted separately on the expansion tank. When using this coolant, the warning sticker is to be mounted on the radiator cap in such a manner prior to delivery that the opening pressure (3) applied on the radiator cap remains visible. For this purpose, see fig. 16/1.




*Ill. 16/1*
*07012*

*1 Warning sticker*

*2 Radiator cap*

*3 Excess-pressure information of radiator cap*

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### 12.2.1) Water-free Coolant

- max. permissible cylinder head temperature
  see Operator's Manual section 10.1) Operating Limits.
- Coolant
  see Operator's Manual section 10.2.1) Coolant.

### 12.2.2) Conventional Glycol / Water Coolant Mixture

The boiling point of conventional glycol / water coolant concentrate depends on the mixture ratio and on the system pressure, i.e. radiator cap.

Corresponding to the following table, the max. permissible cylinder head temperature is limited depending on the coolant concentrate used and may not be exceeded.

| radiator cap | max. permissible cylinder head temperature |
|---|---|
| 0.9 bar (13psi) | 115 °C (239 °F) |
| 1.2 bar (17.5psi) | 120 °C (248 °F) |

*07030*

During exclusive operation within the max. permissible cylinder head temperature, the following coolant can be used in the corresponding mixture ratio:

*07001*

* or equivalent

** 50% antifreeze concentrate and 50% pure water, or an equivalent premixed liquid

■ CAUTION: The antifreeze (frost protection) of this mixture is to be observed according to the manufacturer's specifications.

■ CAUTION: The correct mixture ratio is to be observed since otherwise the coolant can thicken and as a result can lead to damages to the cooling system.

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## 12.3) Requirements on the cooling system

■ ATTENTION: All components of the cooling system have to be secured suitably.

▲ WARNING: The size and layout of the cooling system must be designed to keep the operating temperatures within the specified limits.

To minimize flow resistance employ radiator with low flow resistance and parallel flow as realized on the original BOMBARDIER-ROTAX radiator and use short hoses and pipelines.

**Coolant hoses:**

- ➪ temperature durability: min. 125°C (257° F)
- ➪ pressure durability: min. 5 bar (73 p.s.i.)
- ➪ nom. inside dia : 25 mm (1")
- ➪ bending radius: min. 175 mm (7")
- ➪ material: Suitable for 100 % Glycol and antifreeze agents.

■ ATTENTION: Pay attention to ozone stability!

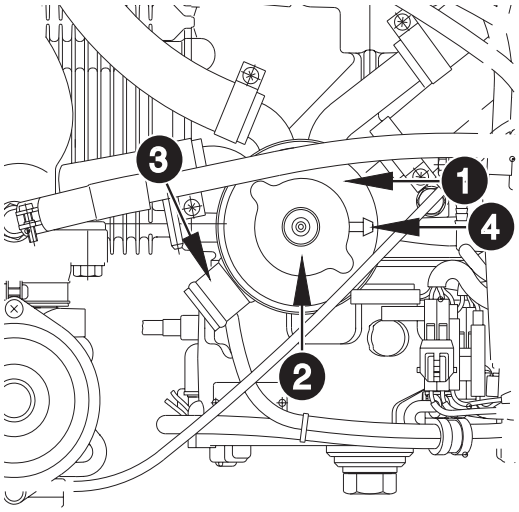
◆ NOTE: If installation require longer distances use aluminium pipes (25 mm (1") inside dia.) instead of hoses.

## 12.4) Size and position of connections

See illustration 17/18/19.

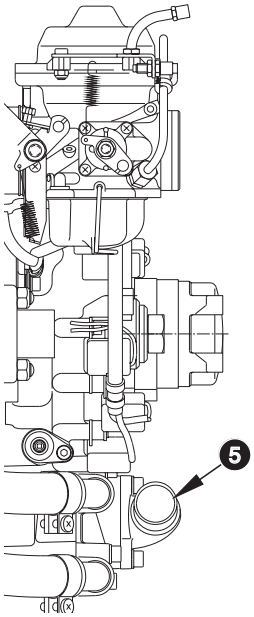
- ➪ expansion tank ❶ with radiator cap ❷

| | |
|---|---|
| to radiator ❸: | outside dia. 25 mm (1") |
| slip-on length | max. 22 mm (7/8") |
| to overflow bottle ❹: | outside dia. 8 mm (3/8") |
| slip-on length | max. 15 mm (9/16") |

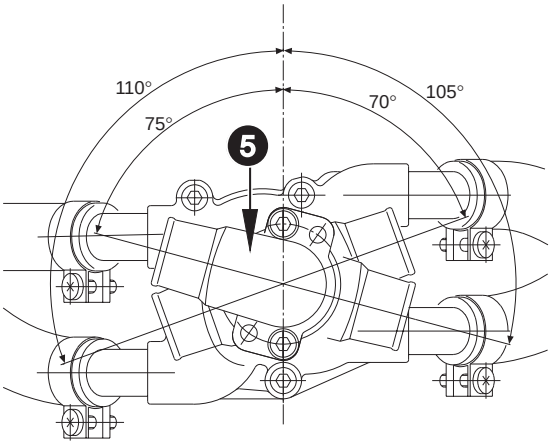



*Ill. 17*

➪ water inlet bend ❺: outside dia. 27 mm (1 1/16")
slip-on length max. 19 mm (3/4")




*Ill. 18*




*Ill. 19*

◆ NOTE: Choose between four possible fitting positions of water inlet bend ❺ appropriate to specific installation (see illustration). The inlet bend is attached to the water pump by two Allen screws M6x20 and lock washers. Tighten screws to 10 Nm (90 in.lb.).

■ ATTENTION: Utilize total slip-on length for hose connection. Secure hoses with suitable screw clamp or by crimp connection.

## 12.5) Coolant capacity

4 cylinder heads: ..... 560 $cm^3$

water pump: ..... 100 $cm^3$

expansion tank: ..... 250 $cm^3$

2 m coolant hose
(18 mm inside dia.) : ..... 500 $cm^3$

total coolant quantity in engine: approx. 1410 $cm^3$ (3/8 gal (us))

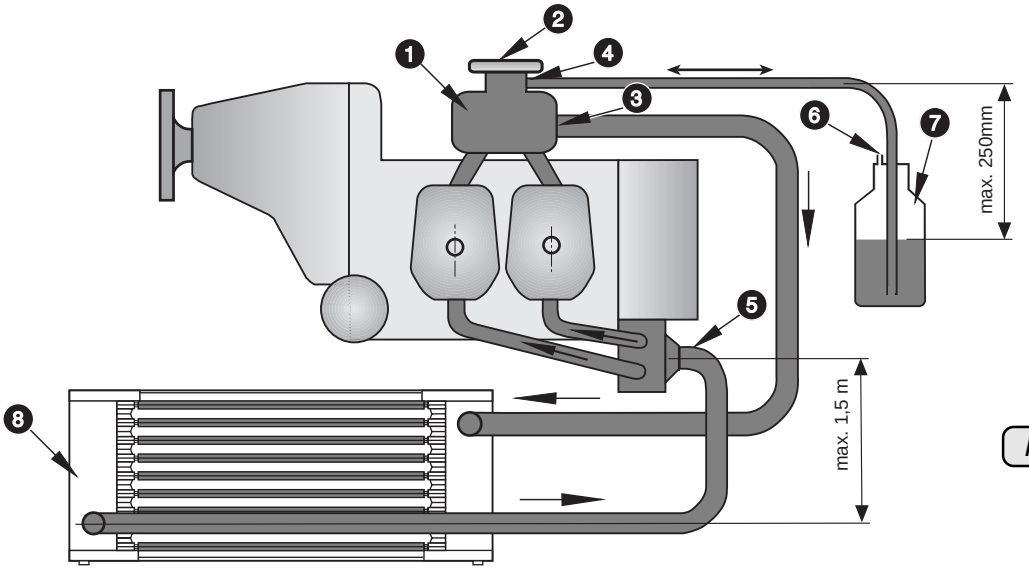
## 12.6) Feasible location of radiator

See illustration 20.

The expansion tank ❶ must always be positioned at the highest point of the cooling system.

■ ATTENTION: If necessary, the radiator outlet opening ❽ may be max. **1,5 m** ( 5 ft) above or below water inlet bend ❺ on water pump (see ill. 20).

◆ NOTE: On the standard engine version the expansion tank ❶ is fitted on top of the engine (see ill. 20).




*Ill. 20*

For proper operation of the cooling system the expansion tank ❶ with pressure cap ❷ has to remain for all possible engine positions on the highest point of the cooling circuit.

Additionally the system needs an overflow bottle ❼ where surplus coolant is collected and returned back into the circuit at the cooling down period.

◆ NOTE: For proper operation keep hose to overflow bottle as short and small as possible.

■ ATTENTION: To warrant the proper operation of the cooling system the delivery head between overflow bottle and expansion tank must not exceed 250 mm (10").

**Requirements on the overflow bottle ❼**

➪ transparent material

➪ unaffected by temperatures from -40° C (-40° F) to +125° C (257° F)

➪ resistant against 100% Glycol and any other anti freeze agent

➪ possible to vent ❻

➪ volume c . 0,5 l (.13 us gal)

◆ NOTE: The overflow bottle ought to be furnished with a label indicating function and content.

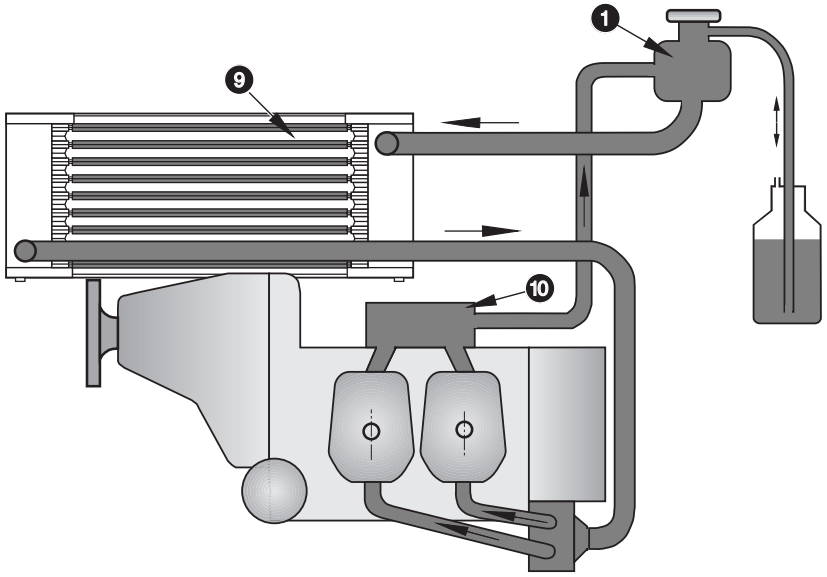
▲ WARNING: Ensure that the overflow bottle will never be empty, otherwise air will be sucked into cooling circuit with ill effect to safe operation of the engine.

## 12.7) General directives for the cooling system

See illustration 21.

BOMBARDIER-ROTAX offers essential parts of the cooling system for this engine such as radiator, overflow bottle etc. (see spare parts list) in the non-certified state. Certification to the latest requirements to FAR or JAR has to be conducted by the aircraft builder.

*Ill. 21*




In an installation as depicted with the radiator ❾ in a higher position than the standard supplied expansion tank, a water accumulator ❿ has to fitted instead of the expansion tank. Additionally a suitable expansion tank ❶ has to be installed at the highest point of the cooling circuit.

■ ATTENTION: The size and type of radiator should be adequate to transfer thermal energy of c. 30 kW (28 BTU/s) at take-off power.

◆ NOTE: Assessment data by experience. For troublefree operation at good airflow a radiator of at least 500 $cm^2$ (78 $in^2$) area has to be used.

The flowrate of coolant in the cooling system can be assumed with c. 55 l/min (16 US gal/min) at 5500 r.p.m.

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## 12.8) Cooling air ducting

Contrary to the cylinder heads, the cylinders are ram air cooled. Plan cooling air ducting according to installation requirement.

▲ WARNING: The cooling air ducting has to be designed and built such, that the operating temperatures are kept within the specified limits, warranted even at **hot day conditions**.

### 12.8.1) General directives for ducting of the cooling air

See illustration 2/3/4.

For front installation in a closed fuselage, ducting of cooling air to the cylinders is recommended. In this case a costly horizontal partitioning can be avoided.

BOMBARDIER-ROTAX developed especially for this application a non-certified cooling air ducting.

▲ WARNING: Certification to the latest requirement like FAR or JAR has to be conducted by the aircraft builder.

**The following recommendations should assist the aircraft builder at the planning of a suitable cooling air ducting.**

- ➪ The cooling air ducting to be adequate to transfer thermal energy of c. 6 kW (5,7 BTU/s) at take-off power.
- ➪ required cross section of air duct: at least 100 $cm^2$ (16 $in^2$)
- ➪ material:
  glass fibre reinforced plastic or heat resistant non-inflammable material.
- ➪ attachment:
  formlocking on engine case and cylinders

◆ NOTE: In case formlocking attachment won`t be adequate, additional attachment is possible on two tapped lugs M8 on top side of engine.

| | Axes | | |
|---|---|---|---|
| attachment points | x axis | y axis | z axis |
| | -300,0 | -30,0 | -14,0 |
| | -300,0 | 30,0 | -14,0 |

| | attachment points |
|---|---|
| max. allowable forces (limit load) in (N) in x, y and z axis | 2 000 |
| max. allowable bending moment (limit load) in (Nm) in x, y and z axis | 50 |
| min. length of thread engagement (mm) | 15 |

■ ATTENTION: The stated limit loads are valid only at utilization of min specified thread length, and must never be exceeded.

Depth of thread 18 mm (11/16").

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# 13) Lubrication system

## 13.1) Description of the system

See Ill. 22.

The BOMBARDIER-ROTAX 914 F engine is provided with a dry sump forced lubrication system with a main oil pump with integrated pressure regulator and a n additional suction pump.

◆ NOTE: The oil pumps are driven by the camshaft.

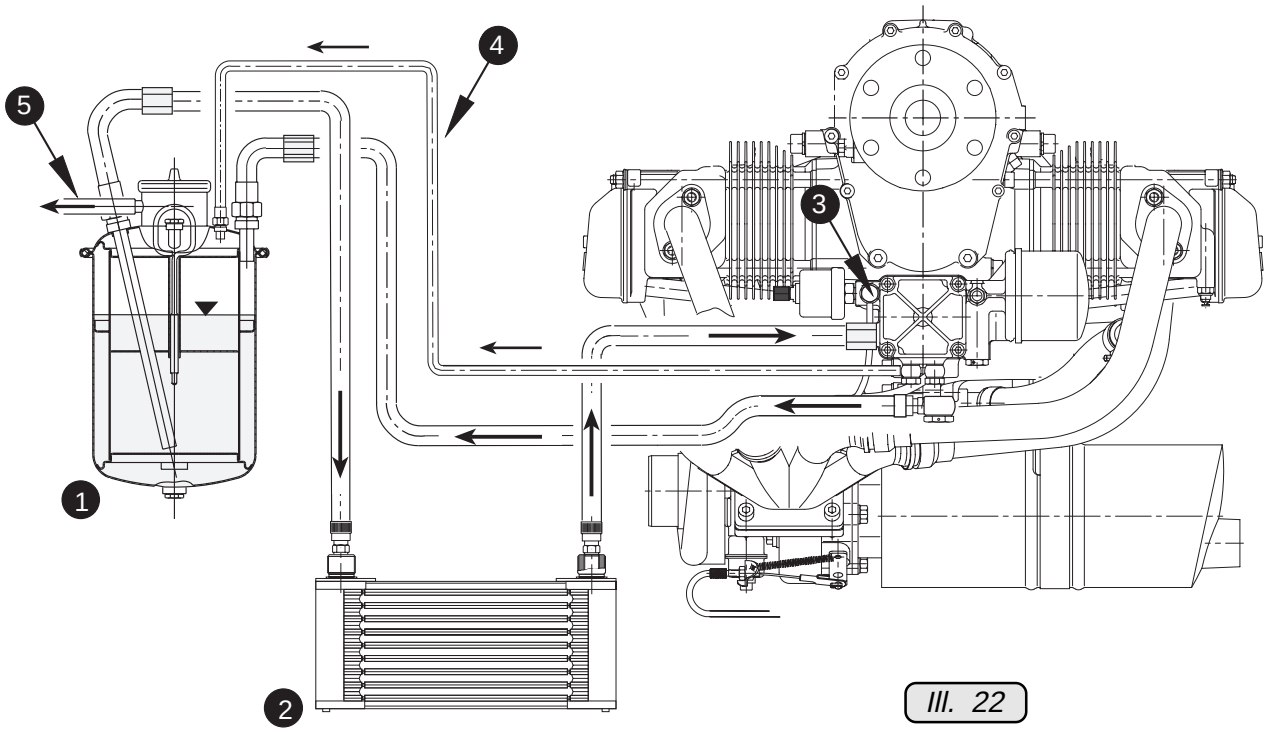
The main oil pump sucks the motor oil from the oil tank ❶ via the oil cooler ❷ and forces it through the oil filter to the points of lubrication (lubricates also the plain bearings of the turbo charger and the propeller governor).

The surplus oil emerging from the points of lubrication accumulates on the bottom of crankcase and is forced back to the oil tank by the blow-by gases.

The turbo charger is lubricated via a separate oil line ❸ from the main oil pump.

The oil emerging from the lower placed turbo charger collects in the oil sump and is pumped back by a separate pump to the oil tank via the oil line ❹.

◆ NOTE: The oil circuit is vented via bore ❺ in the oil tank.




*Ill. 22*

For the completion of the lubrication system only the following connections need to be established:

**Lubrication circuit engine (main oil pump)**

oil tank (outlet) ➪ oil cooler
oil cooler ➪ oil pump (inlet)
oil return ➪ oil tank (inlet)
oil tank ➪ venting line

**Oil circuit turbo charger (suction pump)**

oil return ➪ oil tank (inlet)

◆ NOTE: In the serial version of the engine an oil tank is included, but no provision is made for attachment of an oil cooler.

▲ WARNING: Certification of oil cooler and connections to the latest requirements such as FAR and JAR has to be conducted by the aircraft builder.

## 13.2) Limits of operation

▲ WARNING: The lubrication system has to be designed such that operating temperatures will not exceed the specified limits.

**Oil pressure:** For oil pressure sensor see ill. 75/76.

max. ..... 7 bar (100 p.s.i.)

■ ATTENTION: Permitted at engine start for a short period.

min. ..... 1,5 bar (22 p.s.i.)
normal ..... 1,5 ÷ 5 bar (22 - 73 p.s.i.)

■ ATTENTION: At full throttle operation the depression **at pump inlet** must be 0,3 bar (4,4 p.s.i.) below the ambient pressure. Reading must be taken at a distance of max. 100 mm (4") before pump inlet. See ill. 24.

**Oil temperature:** Oil temperature sensor, see ill. 73/74.

max. ..... 130° C (266 ° F)
min. ..... 50° C (120 ° F)
most favourable oil temperature ..... ca. 90 ÷ 110° C (190 - 250 ° F)

▲ WARNING: At operation below nominal oil temperature formation of condensate in the lubrication system might influence oil quality.

## 13.3) Requirements on the oil- and venting lines

**Oil lines**

**Oil circuit, engine (main oil pump)**

- Temperature durability: mind. 130°C (266 ° F)
- Pressure durability: mind. 10 bar (145 p.s.i.)
- Bending radius: mind. 70 mm (2,75 in.)
- Minimum inside dia. of oil lines in reference to total length

  length up to ...1m (3 ') min. 11 mm ø (.43")
  length up to ...2 m (6' 6") min. 12 mm ø (.47")
  length up to ...3 m (10') min. 13 mm ø (.51")

**Oil circuit, turbo charger (suction pump)**

- Temperature durability: mind. 130°C (266 ° F)
- Pressure durability: mind. 10 bar (145 p.s.i.)
- Bending radius: mind. 70 mm (2,75 in.)
- Minimum inside dia. of oil lines in reference to total length

  length up to ...1m (3 ') min. 11 mm ø (.43")
  length up to ...2 m (6' 6") min. 12 mm ø (.47")

**Venting line of oil tank**

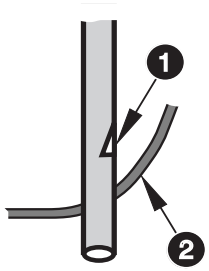
See ill. 22.

- Route the line without kinks and avoid sharp bends.

◆ NOTE: Water is a by-product of combustion. Most of this water will dissipate from the combustion chamber with the exhaust gases.

A small amount will reach the crankcase and has to be disposed through the venting line of oil tank via oil return line.

- The venting line must be routed in a continuous decline or furnished with a drain bore at it's lowest point to drain possible condensate.
- The venting line has to be protected from any kind of ice formation in the condensate. Protection by insulation, or routing in a hose with hot air flow or by furnishing venting line with a bypass opening ❶ before passing through cowling ❷. See ill. 23.




*Ill. 23*

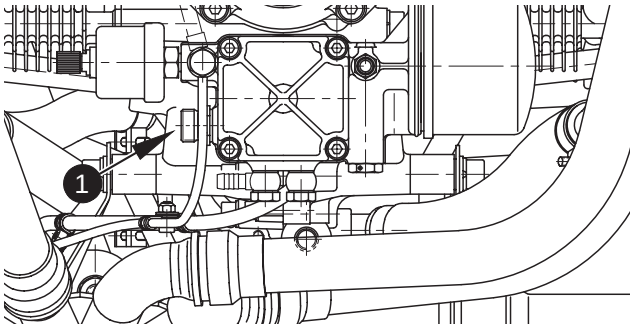
## 13.4) Connecting dimensions and location of connections

■ ATTENTION: Utilize the full slip-on length for hose connections. Secure hoses with suitable screw clamp or by crimp connection.

### 13.4.1) Oil circuit (engine)

See ill. 24/25.

**Oil pump** (inlet) ❶ ..... thread M18 x 1,5 x 11



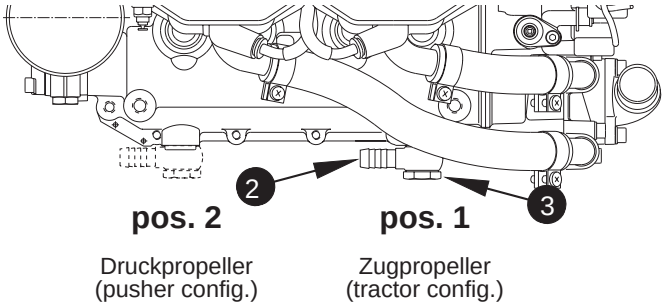

◆ NOTE:
Suitable for use of a swivel joint. See ill. 28.
Tightening torque 25 Nm (220 in.lb)

*Ill. 24*

**Oil return**

According to propeller configuration choose the appropriate connection for the oil return line.
Position **1** for tractor or **2** for pusher configuration. See ill. 28.

hose nipple ❷ ..... 10 DIN 7642
outside dia. ..... 12 mm (0,5 in.)
slip-on length ..... max. 24 mm (max. 0,94 in.)




Tightening torque of banjo bolt ❸
M16x1,5x28: 35 Nm (310 in.lb).

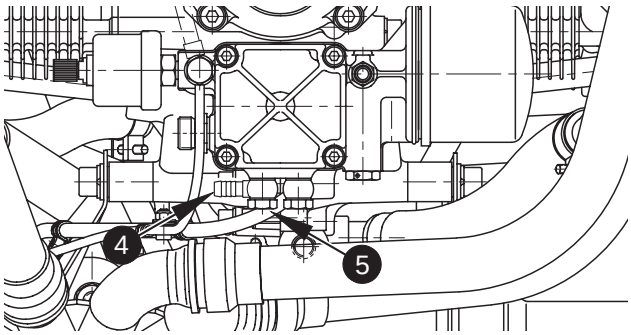
*Ill. 25*

### 13.4.2) Oil circuit (turbo charger)

See ill. 26.

**Oil return**

hose nipple ❹ ..... 4/6 DIN 7642
outside dia. ..... 8 mm (0,31 in.)
slip-on length ..... max. 20 mm (0,79 in.)



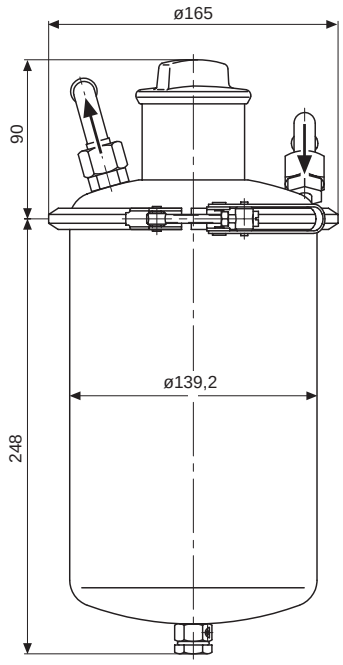

Tightening torque of banjo bolt ❺
M10x1x19: 17 Nm (150 in.lb)

*Ill. 26*

### 13.4.3) Oil tank

See ill. 27/28.

The oil tank is furnished with 2 screw connections M18x1,5 and with a tapped hole (M10x1).




*Ill. 27*

#### Connections for oil circuit (engine)

Oil inlet ❻ and outlet ❼ via standard swivel joint and connecting bend ❽.

2x connecting bend 90° ❽

| | | |
|---|---|---|
| outside dia. | 12 mm | (0,47 in.) |
| slip-on length | max. 24 mm | (0,94 in.) |
| tightening torque | 25 Nm | (220 in.lb) |

1x venting nipple ❾

| | | |
|---|---|---|
| outside dia. ..... | 8 mm | (0,31 in.) |
| slip-on length ..... | max. 15 mm | (.59 in.) |

#### Connection for oil circuit (turbo charger)

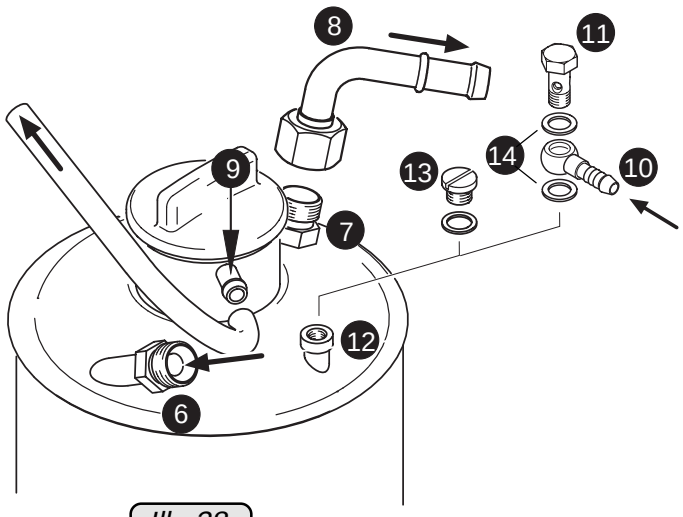
hose nipple ❿ 4/6 DIN 7642

| | |
|---|---|
| outside dia. | 8 mm |
| slip-on length | max. 20 mm |

tightening torque of the banjo bolt ⓫ M10x1x19: 17 Nm (150 in.lb)

◆ NOTE: In the standard supply volume the connection ⓬ is closed by the plug screw ⓭.

This screw plug has to be removed and is replaced by the hose nipple ❿, sealing ring ⓮ 10x14 DIN 7603 and banjo bolt ⓫.




*Ill. 28*

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## 13.5) Feasible position and location of the oil tank

See illustration 29.

➪ The longitudinal axis z3 to be parallel to z-axis of the system of coordinates. Tolerated deviation of parallelism: ± 10°

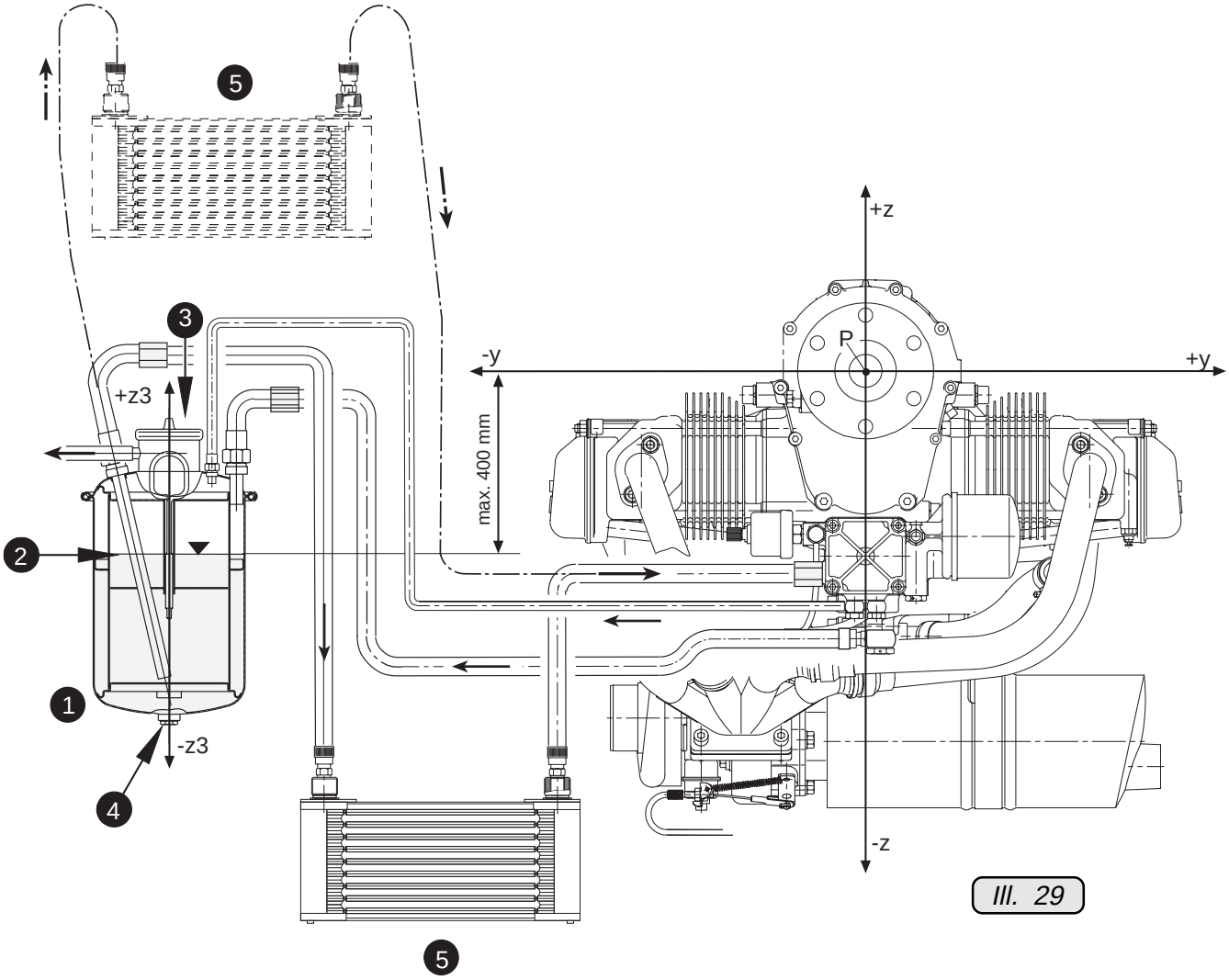
◆ NOTE: Above notice is valid for both planes.

➪ The oil tank ❶ has to be positioned in its z-axis such that the oil level ❷ is always between 0 and -400 mm on the z-axis .

▲ WARNING: At higher location of the oil tank oil might trickle through clearances at bearings into crankcase during longer periods of engine stop. If fitted too low it might badly effect the oil circuit.

➪ Install the oil tank free of vibrations.

➪ Oil tank cover ❸ and oil drain plug to be easily accessible.




*Ill. 29*

## 13.6) Feasible position and location of the oil cooler

See illustration 29.

➪ On principle the oil cooler ❺ has to installed below the engine. See Illustration 29.

■ ATTENTION: If this position is not be practicable, install with connections upwards i.e. in positive direction on z-axis. See Illustration. This will prevent an unintentional draining of the oil cooler at longer engine stop.

▲ WARNING: The oil cooler has to be planned and installed such that the specified operating temperatures are maintained and the max. values are neither exceeded nor fall below.

This state has to be warranted for "hot day conditions" too!

If need be, take appropriate measures like changing size of cooler, partial covering of cooler etc.

## 13.7) General notes on oil cooler

BOMBARDIER-ROTAX offers for this engine a non-certified oil cooler (see spare parts list).

▲ WARNING: Certification of this cooler to the latest requirements such as FAR or JAR has to be conducted by the aircraft builder.

■ ATTENTION: The oil cooler has to be designed to dissipate approx. 9 kW (8,5 BTU/s) heat energy at take-off power.

◆ NOTE: From years of experience we recommend an oil cooler size of at least 160 $cm^2$ (25 $in^2$), provided that air flow is adequate.

## 13.8) Filling capacity

➪ Oil quantity without oil cooler and connecting lines 3 l (0,8 US gal), min. 2 l (0,5 US gal).

# 14) Fuel system

## 14.1) Description of system

See Ill. 30.

The fuel flows from the tank via a coarse filter/water trap ❶ to the two electric fuel pumps ❷ connected in parallel. From the pumps fuel passes on via the fuel pressure control ❸ to the two carburetors.

Via the return line ❺ surplus fuel flows back to the fuel tank and suction side of fuel system.

◆ NOTE: The fuel pressure control ensures that the fuel pressure is always maintained approx. 0,25 bar above the variable boost pressure in the "airbox" and thus ensures proper operation of the carburetors.

On the standard version of the engine the fuel lines from fuel pressure control to the carburetors have already been laid.

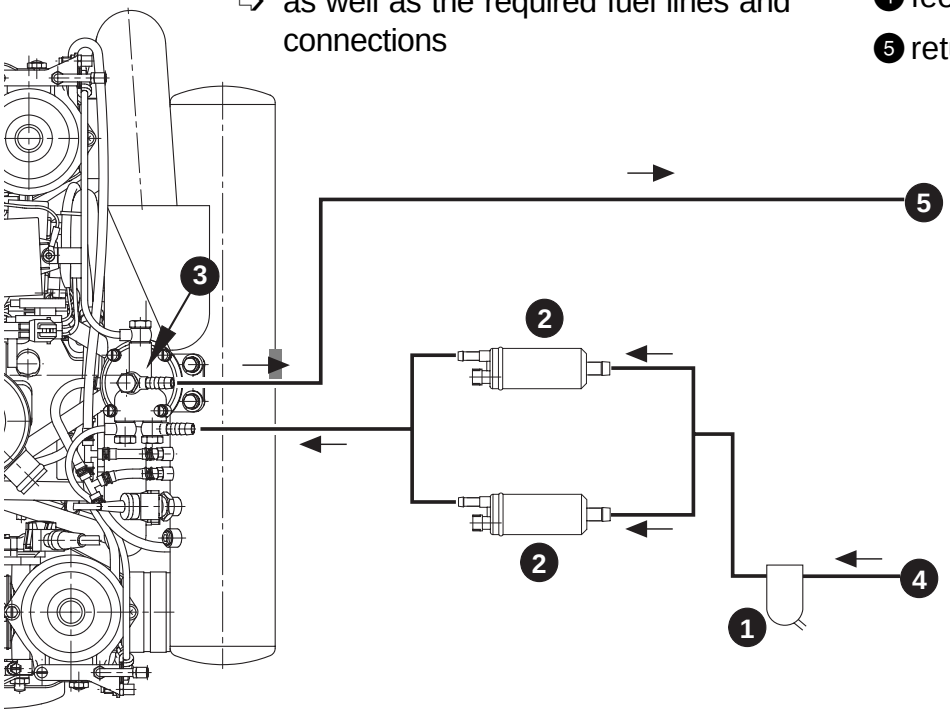
The fuel system from tank to the fuel pressure control has to be installed by the aircraft builder.

The fuel system includes the following items:

- ⇨ tank
- ⇨ coarse filter
- ⇨ watertrap
- ⇨ fire cock
- ⇨ 2 electric fuel pumps
- ⇨ as well as the required fuel lines and connections

legend:

❶ coarse filter / watertrap
❷ 2 x electric fuel pump
❸ fuel pressure control
❹ feeding line from tank
❺ return line to tank




*Ill. 30*

Only the following connections per Ill. 30 have to be established:

- ⇨ Feeding lines to suction side of the electric fuel pumps ❷
- ⇨ lines from pressure side of the electric fuel pump to inlet of fuel pressure control ❸
- ⇨ Returnline from fuel pressure control to oil tank

## 14.2) Operating limits

▲ WARNING: Design and layout of the fuel system has to warrant engine operation within the specified limits.

**Fuel pressure:**

max. ..... airbox pressure + 0,35 bar
min. ..... airbox pressure + 0,15 bar
nominal ..... airbox pressure + 0,25 bar

The fuel pressure of the electric fuel pump must not exceed the manifold pressure by more than 0,35 bar (5 p.s.i.)

▲ WARNING: Fuel pressure in excess of stated limit can lead to an override of the float valve with subsequent engine stop.

◆ NOTE: On the standard engine no connection is provided for measuring the fuel pressure. Refer to chapter 14.5.

## 14.3) Requirements of the fuel system

➪ **fuel lines:** See Ill. 30.

▲ WARNING: Fuel lines have to be established to the latest requirements such as FAR or JAR by the aircraft builder.

■ ATTENTION: The fuel return ❺ must be a line of low flow resistance. Max. tolerated pressure loss is **0,1 bar** (1,5 p.s.i.) between fuel pressure control and tank inlet with **both** electric fuel pumps in action. Otherwise the carburetors could flood. Secure fuel hoses with suitable screw clamps or by crimp connection.

■ ATTENTION: For prevention of vapour locks, all the fuel lines on the suction side of the fuel pump have to be insulated against heat in the engine compartment and routed at distance from hot engine components, without kinks and protected appropriately.

At very critical conditions e.g. problems with vapour formation the fuel lines could be routed in a hose with cold air flow.

➪ **Fuel filter:** See Ill. 30.

**Coarse filter:** on fuel tank as per valid certification

**Fine filter:** in the feed line from tank to the 2 fuel pumps an additional fine filter with meshsize 0,1 mm has to be provided.

The filter has to be controllable for service. A combination of filter/ watertrap is recommended.

➪ **Fuel temperature:**

To prevent vapour locks temperatures in excess of 36°C (100°F) are not permissible in the vicinity of fuel lines, float chamber and such.

## 14.4) Connecting dimensions, location of joints and directives for installation

### 14.4.1) Electric fuel pump

See outline of fuel pump, Ill. 30, Ill. 31 and 32.

Design: self priming vane pump

Volume of supply: electric fuel pump with attachment kit, 2 hose clamps and various attachment elements

Weight: 0,35 kg (.8 lb) inclusive attachment items

Fitting position: horizontal or vertical

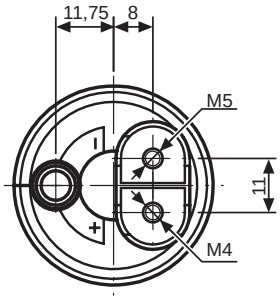
Connections: See Ill. 31.

Inlet ❶ (suction side)

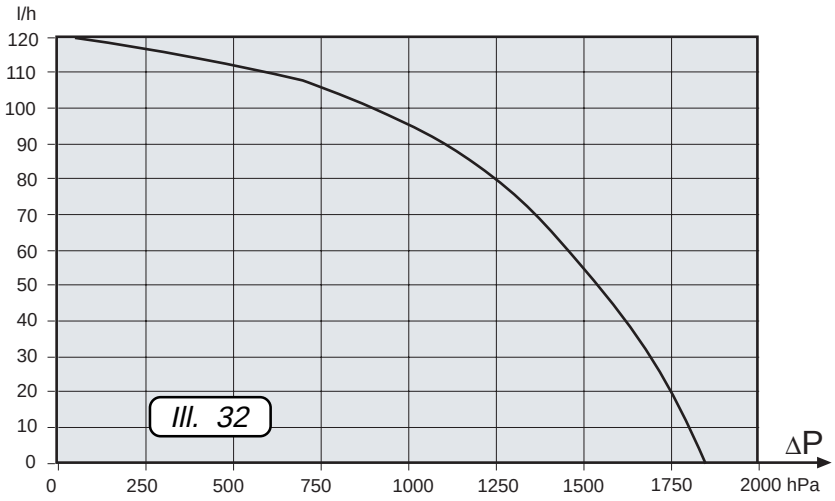
Outlet ❷ (pressure side)

■ ATTENTION: Utilize the complete slip-on length on all hose connections. Secure fuel hoses with suitable screw clamps or by crimp connection.

Delivery rate/pressure : See diagram Ill. 32.

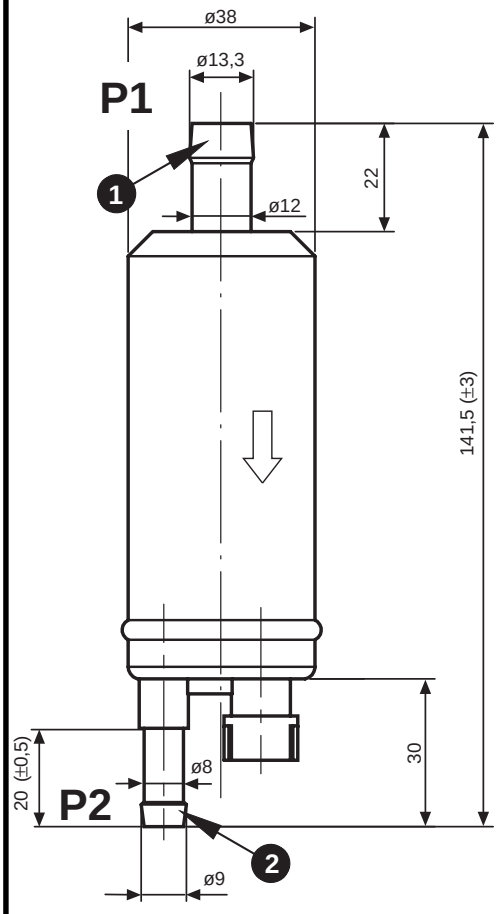



*Ill. 31*




*Ill. 32*

$$\Delta P = P2 - P1$$




The diagram shows the delivery rate of the electric fuel pump over pressure.

Take note of the following:

➪ diagram outlines min. capacity at nominal voltage on pump

➪ pressure and suction head are "ZERO"

➪ graph is effective on the seasoned pump only, running-in period approx. 30 min.

◆ NOTE: A capacity increase of approx. 20% is feasible by running-in process.

◆ NOTE: There is no need for a checkvalve for the operation of the two electric fuel pumps since the pump itself won't allow any passage against correct direction of flow

■ ATTENTION: Employ GENUINE-BOMBARDIER-ROTAX fuel pumps only. Non-compliance will release BOMBARDIER-ROTAX from any liability.

Place of installation:

➪ Installation of the fuel pumps principally near the fuel tank to gain advantage of a cool location, especially important at tendency of vapour locks.

➪ Install the pump in low position, if possible below fuel tank, free of vibrations. Therefore, fuel pump attached directly on the engine is not permitted.

**Max. suction head 250 mm (10 in).**

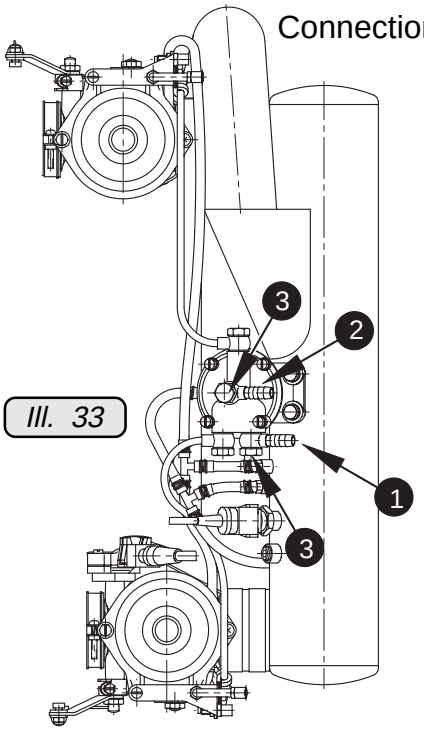
▲ WARNING: Certification to the latest requirements such as FAR or JAR has to be conducted by the aircraft builder.

▲ **WARNING: Installation of the fuel pumps in the engine compartment is not permitted since the fuel pumps are not of a fire resistant construction and because of the risk of vapour lock formation.**

▲ WARNING: Should the situation arise, certification to the latest requirements such as FAR or JAR would have to be conducted by the aircraft builder.

### 14.4.2) Fuel pressure control

See outline of fuel pressure control ❸ ,Ill. 30 and Ill. 33.




*Ill. 33*

Connections: **inlet** ❶ (feed line from fuel pumps) and
**outlet** ❷ (fuel return to tank)

hose nipple .....4/6 DIN 7642
outside dia. ø ..... 8 mm (5/16")
slip-on length ..... max. 20 mm (3/4")

tightening torque of the
banjo bolts ❸ .M10x1x19: 17 Nm (150 in.lb)

■ ATTENTION:
The fuel return from connection ❷ must be a line of low flow resistance. Prevent any restrictions of section or blockage, otherwise the carburetor could flood.

■ ATTENTION:
Utilize the full slip-on length at hose joints. Secure hose with suitable screw clamp or by crimp connection.

◆ NOTE: The control of the fuel pressure is achieved by a valve activated from a diaphragm. Reverence pressure is the boost pressure in the airbox.

The arrows on top of the fuel pressure control are of no significance for this application.

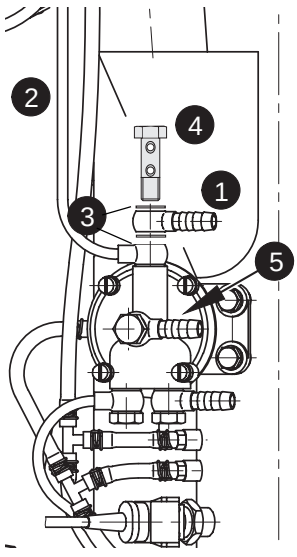
### 14.5) Notes on checking of fuel pressure

See Ill. 34.

There is no standard connection provided to measure the full pressure. For general observation and at engine troubles fuel pressure readings would be helpful.

*Ill. 34*

A feasible connection would be an additional hose nipple 4/6 ❶ joined to the fuel line ❷.




➪ remove banjo bolt M10x1x19. Fit additional hose nipple (with integrated orifice) ❶ and 2 sealing rings ❸ by use of a longer banjo bolt ❹ M10x1x30.

tightening torque of the banjo bolt: 17 Nm (150 in.lb).

■ ATTENTION: At tightening of the fuel lines ❷ support the specific line, to prevent any internal stresses.

◆ NOTE: The illustration 34 shows the additional hose nipple connected to fuel line of carburetor 1/3. The additional nipple can be fitted of course to any other connections with the exception of **outlet** ❺.

All the necessary items are available as spare parts.

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## 15) Carburetor

See illustration 35.

The carburetors on the standard engine are already attached by a flexibly flange. Only connections of the Bowden cable for throttle and starting carb have to be established.

It is recommended, to make the adjustment of the Bowden cable after engine installation has been completed, to ensure exact final adjustment.

■ ATTENTION: In case this has not been taken care of, verification of the throttle position is required prior to the trial run. Refer to chapter 15.5.

### 15.1) Requirements on the carburetor

The carburetors are positioned above the exhaust sockets. Below the carburetors one each drip tray ❶ with a draining connection is fitted which acts as heat shield as well.

▲ WARNING: In the area of the float chamber the temperature limit of the fuel must not be exceeded.

If need be provide additional insulation or heat shields. Certification to the latest requirements such as FAR or JAR has to be conducted by the aircraft builder.

**Drainage piping**

▲ WARNING: Connect draining lines without fail, otherwise emerging fuel from a possible leakage could drip onto the exhaust system. RISK OF FIRE!

➪ The lines have to be routed such that in case of a damage the surplus fuel is drained off suitably.

➪ Route the lines without kinks and avoid narrow bends

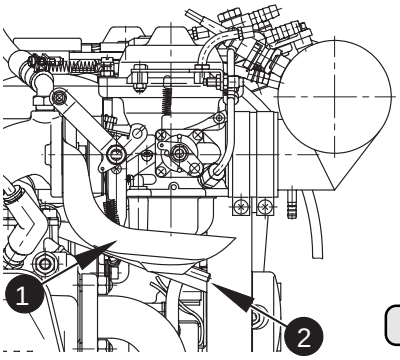
➪ Route the lines with a continuous decline.

➪ The lines have to be protected against any kind of blockage e.g. by formation of ice.

■ ATTENTION: With closed or blocked leakage piping, fuel could end up on exhaust system. RISK OF FIRE!

**Connecting nipple ❷ for leakage line**

outside dia. ø ..... 6 mm (1/4")
slip on lengthmax. 17 mm (11/16")




*Ill. 35*

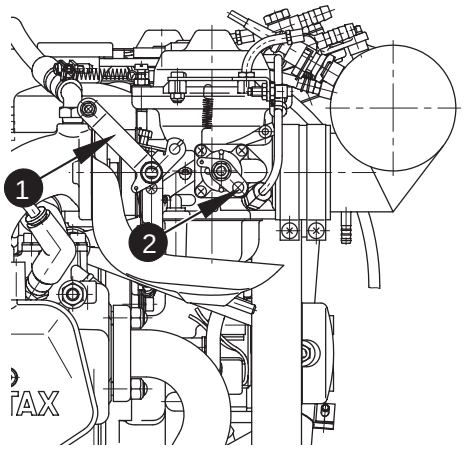
## 15.2) Connections for Bowden-cable actuation and limit load.

See Ill. 36/37.

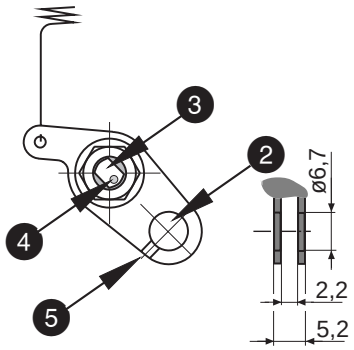
➪ connection for throttle actuation ❶

| | |
|---|---|
| connection on throttle lever: | set screw M 5x12<br>tightening torque: 4 Nm (35 in.lb)<br>(suitable for 1,5 mm steel wire) |
| action travel: | 65 mm (2 $^{1}/_{2}$") |
| actuating force: | min.1,5 N (.3 lb)<br>max.8 N (1,8 lb) |
| limit load: | 20 N (4,5 lb) |

◆ NOTE: Throttle opens by spring.




*Ill. 36*




*Ill. 37*

➪ connection for starting carb (choke) actuation ❷

| | |
|---|---|
| connection on choke lever: | clamping nipple 6<br>(suitable for 1,5 mm steel wire) |
| action travel: | 23 mm ($^{15}/_{16}$") |
| actuating force: | min.10 N (2,2 lb)<br>max.24 N (5,4 lb) |
| limit load: | 100 N (22 lb) |

**Directive for choke actuation**

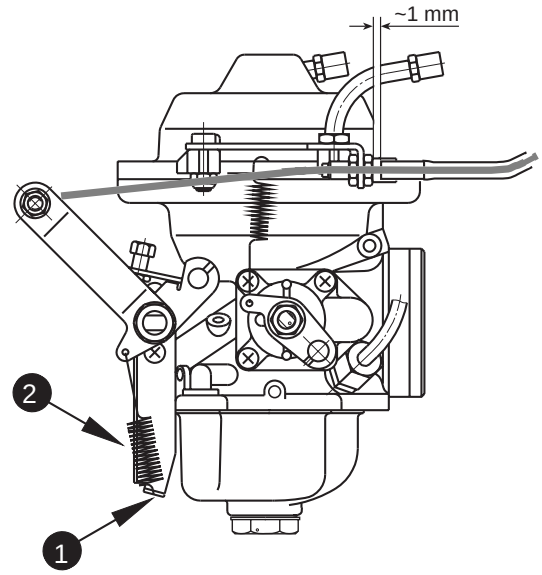
The choke shaft ❸ is marked ❹. This mark has to point towards cable engagement ❺.

## 15.3) Requirements on cable actuation

See Ill. 38.

The two throttles have to be controlled by two separate Bowden cables working synchronous.

Adjust the cables to a free travel of 1 mm (.04 in).




*Ill. 38*

▲ WARNING: With throttle lever not connected the carb will remain fully open. **The home position of the CD-carburetor is full throttle!**

Therefore never start engine without connecting throttle lever first.

▲ WARNING: Route Bowden cable in such a way that carb actuation will not be influenced by any movement of engine or air frame, thus possibly falsifying idle speed setting and carb synchronisation.

Adjust Bowden cable such that throttle and choke can be fully opened and closed.
Use Bowden cable with minimized friction so that the spring on the throttle can open the throttle completely. Otherwise increase pretension of spring by bending lever flap ❶ or fit a stronger return spring, ❷ or a cable with pull-push action would have to be used.

## 15.4) Requirements on the throttle lever

See Ill. 39.

From throttle position 108 to 110 the boost pressure rises rapidly and the throttle becomes very sensitive in this range. Therefore try to prevent this small range or if setting for take-off performance pass this range speedily.

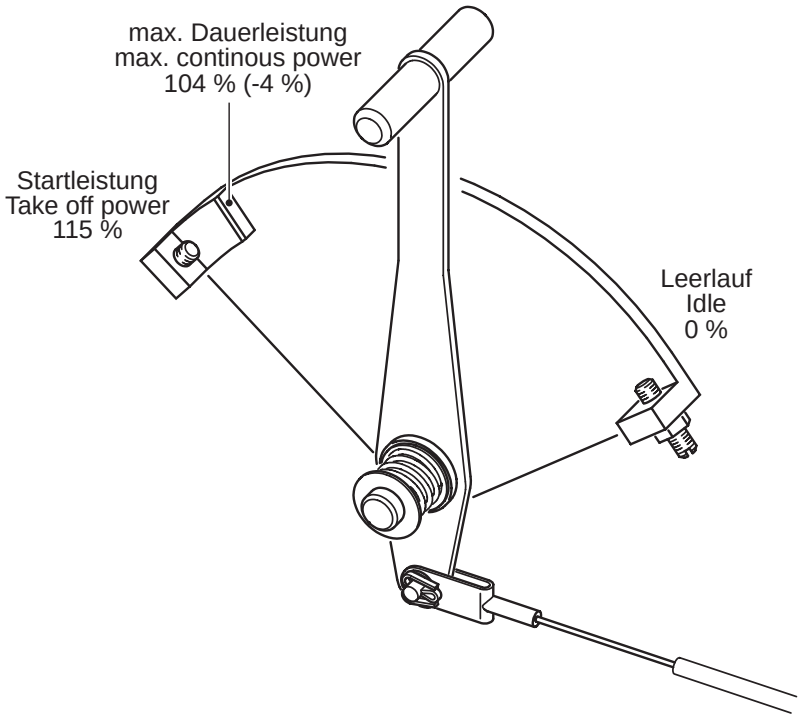
**Consult also the chapter "electric system" for the description of the system.**

For this reason it is recommended to assist the pilot with an visual/manual arrangement at setting for max. cruise performance.

**A detent on your throttle lever at max. continuous power would be most suitable.** Provide this detent at throttle position 104% (–4%) corresponding to 8 - 9 mm (5/16" - 11/32") travel before full throttle stop.

The sketch (Ill. 39) depicts a feasible arrangement.

The throttle lever is pressed onto throttle gate and comes to a stop at max. continuous power. Against the spring force the throttle lever will be released from the detent and can be moved further to take-off performance.




*Ill. 39*

■ ATTENTION: Adjustable positive stops for idle- and full throttle position are of course required.

These stops have to be designed such to render adjustibility and to prevent bending of the idle stop on the carburetor.

## 15.5) Location and determination of the throttle position for max. continuous power

It is a necessity for trouble free engine operation that the pilot can locate the exact throttle position for max. continuous performance.

■ ATTENTION: A manual determination (e.g. by a graduated disk) is not precise enough and therefore not permitted.

The exact determination is achieved electronically by a PC program especially developed for this engine.

### 15.5.1) Required items

➩ PC with processor 80 286 or higher level with
a working storage of min. 640 KB RAM
graphic card EGA or VGA
interface COM 1
operating system MS-DOS 5.0 or higher level

◆ NOTE: We recommend a laptop- or notebook-computer, since these units can be utilized also directly on engine or aircraft. The computer will be required on maintenance tasks too.

➩ communication program "TLR 43a.exe" between TCU and computer

➩ decoding unit (Dongle) with data cable to connect to computer

◆ NOTE: All the required items except the computer are available in form of a monitoring kit.

### 15.5.2) General information about the communication program

➩ The software is property of BOMBARDIER-ROTAX. Duplication is only permitted for transmission on a fixed disk or for back up and recording.

➩ **The TCU must be switched on.**

▲ WARNING: Ensure engine ignition "off" and secured against unintentional "ON"

➩ necessary connections

Connect decoding unit (Dongle) with the RS 232 9-pole plug of the cable harness and then connect data cable of the decoding unit (Dongle) with the interface **"COM 1"** of the computer.

◆ NOTE: I.e. the decoding unit (Dongle) has to be connected into the circuit between cable harness and computer.

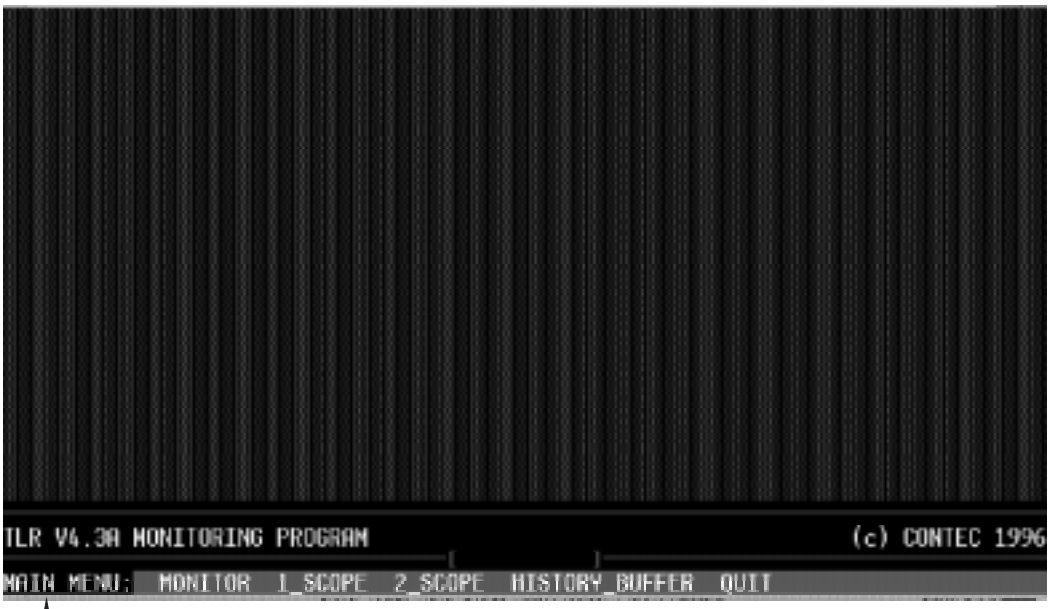
➪ **start of the program:** see Ill. 40.

The program can be started by two different methods:

1) Call of the program direct from MS-DOS. Name of the program "tlr 43a.exe"
2) Direct via windows (file manager) by double strike. Name of the program "tlr 43a.exe"

You are on the main menu now

*Ill. 40*




➪ **starting of the sub programs,** see Ill. 41.

The sub programs are always listed on the bottom line and activated by input of the first letter of the program, e.g. **"M"** for MONITOR

◆ NOTE: The key "ESC" will transfer you always back to the main menu.

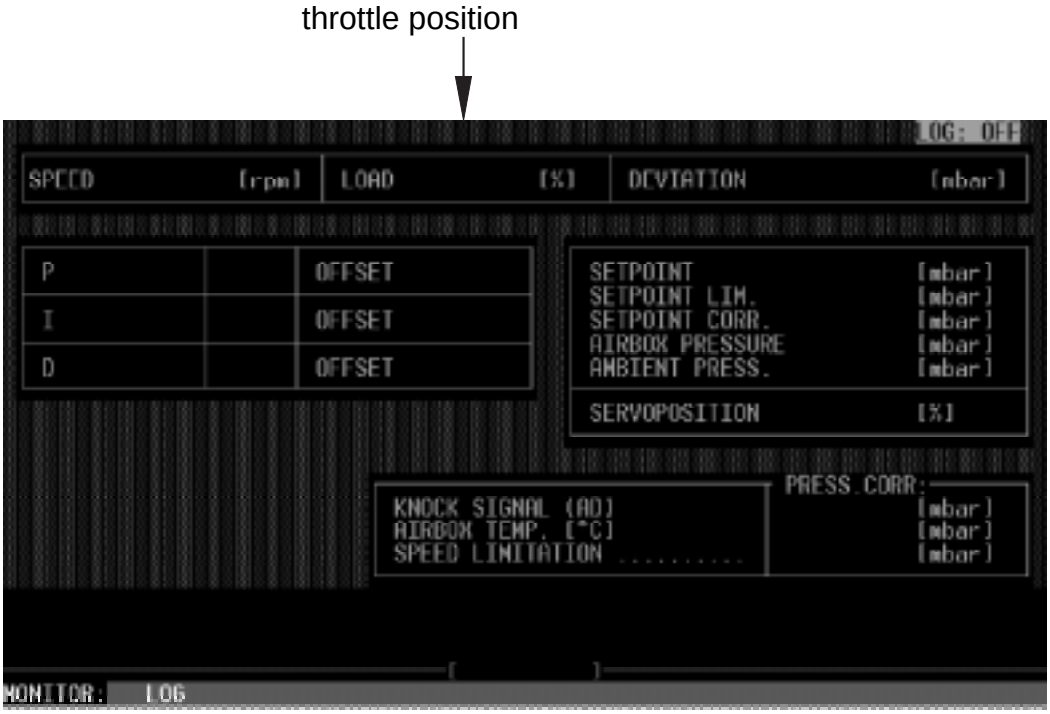
◆ NOTE: If the bottom line ❶ displays "Error" instead of the sub program, some connection between TCU and computer has been interrupted. Checking of all plug connections between TCU and computer is necessary.

*Ill. 41*

### 15.5.3) Checking of the throttle position

See Ill. 42.

➪ Start of the sub program MONITOR.




*Ill. 42*

Throttle position is displayed in the middle of the top line (carb 2/4)

**0 %** ➪ **throttle completely closed**

**115 %** ➪ **throttle fully open**

➪ visually check whether the throttle on both carburetors can be fully opened and closed. If necessary correct the installation setting

➪ check of the display with throttle completely closed:
**nominal: 0°** **tolerance +3%**

➪ check of the display with throttle fully open:
**nominal: 115 %** **tolerance -2%**

■ ATTENTION: Check whether indication is linear over the complete range from 0% to 115% i.e. the 115% position is not indicated before throttle is fully open.

➪ Check of the display at max. continuous power.

■ ATTENTION: Throttle lever must be in positive stop position

nominal: 100 % tolerance +3%.

▲ WARNING: This check of position is only meaningful and allowed, if idle- and full throttle position are within the allowance variation.

If the throttle position for idle and full throttle are not within the allowance variation or if not proceeding linear, then a new calibration of the throttle position is absolutely necessary. Refer to Maintenance Manual 914 F.

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## 16) Air intake system

See Ill. 43.

The pressure side intake system from turbo charger to the carburetors is included in the volume of supply. Only the airduct to turbo charger and drainage line of airbox have to established.

### 16.1) Operating limits

**Temperature in airbox:**

max. ..... 72°C (162°F)

Low air temperature in the airbox is favourable for engine performance and against knocking tendency at combustion. If need be install intercooler.

### 16.2) Requirements on the air intake system

▲ WARNING: Carb icing is a common reason for engine trouble. No implements are included in the supply volume for preheating of the intake air.

Because of the generated heat by turbo charging preheating of the intake air is possibly not necessary. But a switch over flap to intake air from the engine compartment is recommended as the air filter could possibly close by formation of ice.

Preheating of the intake air will result in performance loss because of the lower air density.

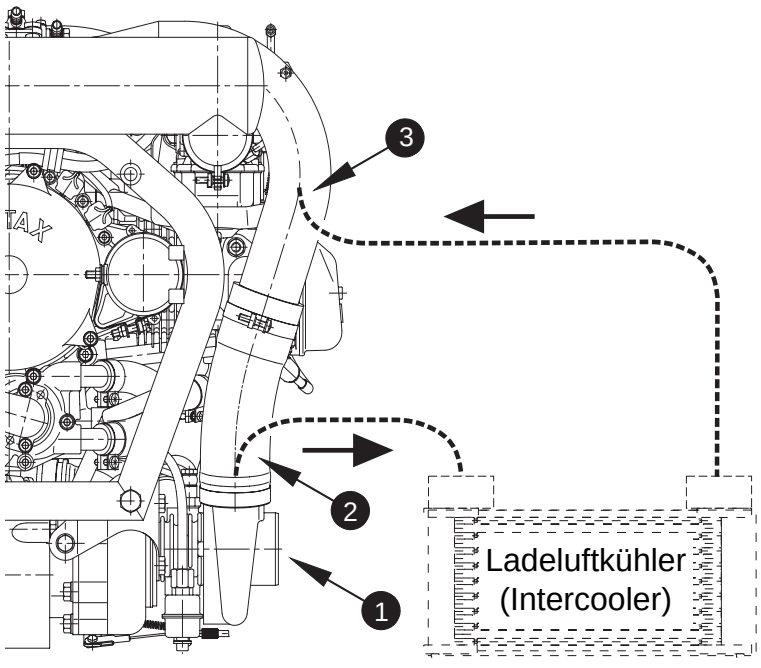
▲ WARNING: All items of the air intake have to be secured against loss.

▲ WARNING: The certification to the latest requirements such as FAR and JAR has to be conducted by the aircraft builder.

**Air intake socket ❶ on turbo charger**

outside dia. ø .....60 mm (2 3/8")
slip-on length .... max. 25 mm (1")

■ ATTENTION: Utilize the full slip-on length on all connection. Secure hoses by suitable screw clamps.




*Ill. 43*

### 16.2.1) Requirements on the intake air ducting

- ➪ max. length of ducting 500 mm (20 in.)
- ➪ min. inside dia. at least outside dia. of the intake socket on turbo charger
- ➪ min. mean bending radius 100 mm (4")

◆ NOTE: Compression process in the turbo charger will heat up air considerably, depending on pressure ratio. Usual temperature rise of 40°C (72°F) at take-off performance.

■ ATTENTION: High engine performance needs air temperature as low as possible at turbo air intake. Therefore the air filter should be located in a recess of the engine cowling or separated from warm air by partitioning such that via on opening ambient air can be aspirated.

Air temperature above the limit will automatically reduce boost pressure with consequent performance loss.

◆ NOTE: The automatic back off on boost pressure will protect the engine against damage by overstressing.

**Notes regarding too high air temperatures in the air box:**

If in case of high intake air temperature the max. air temperature in the airbox is frequently or permanently above the limit, the arrangement of air intake has to be improved or an intercooler has to be installed.

◆ NOTE: Intercooler is not in the supply volume.

Intercooler has to be installed between pressure side of turbo ❷ and inlet ❸ into airbox.

**Requirements on the intercooler:**

- ➪ a minimum flow rate of 300 $m^3$/h (390 $yd^3$/h) has to be warranted for all conditions
- ➪ the pressure loss must not exceed 15 hPa

■ ATTENTION: No additional forces or moments are allowed on turbo charger or airbox, therefore the intercooler has be supported independent and free of vibrations.

▲ WARNING: The certification to the latest requirements such as FAR and JAR has to be conducted by the aircraft builder.

### 16.2.2) Airfilter

■ ATTENTION: A minimum flow rate of 300 $m^3$/h (390 $yd^3$/h) has to be warranted for all conditions.

The pressure loss must not exceed 5 hPa.

▲ WARNING: Use only filter elements which will not tend to restrict the flow when in contact with water.

### 16.2.1) Airbox

See Ill. 44.

The airbox is furnished with 2 drain holes at the lowest position possible.

The holes are necessary to drain fuel from flooding float chambers caused by badly closing float valve.

◆ NOTE: This drain bores are very small (1,5 mm (1/16") dia.). Compensation of process conditions is taken care of by the TCU.

**Drainage lines:**

▲ WARNING: Connect draining lines without fail, otherwise emerging fuel could drip onto the exhaust system.
RISK OF FIRE!

➪ The lines have to be routed such that in case of damage the surplus fuel is drained away suitably.

➪ Route the lines without kinks and avoid narrow bends.

➪ Route the lines with a continuous decline.

➪ The lines have to be protected against any kind of blockage e.g. by formation of ice.

■ ATTENTION: With closed or blocked drainage bores fuel could flow into combustion chamber, possibly ruining the engine by hydraulic lock.

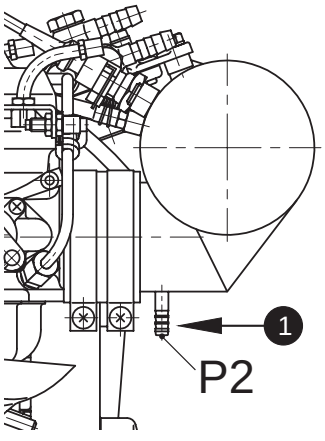
**Connecting nipple ❶ of drainage line**

outside dia. ø ..... 6 mm (1/4")
slip-on length ..... max. 17 mm (11/16")

■ ATTENTION: Utilize the complete slip-on length. Secure hoses by suitable screw clamps or by crimp connection.

**Location of connecting nipple P2:**

*Ill. 44*




| | axis | | |
|---|---|---|---|
| connecting nipple | x-axis | y-axis | z-axis |
| cylinder side 1/3 | -568 | -180 | -20 |
| cylinder side 2/4 | -590 | 180 | -20 |

## 16.3) Notes to employment of the air filter

BOMBARDIER-ROTAX offers a dry type air filter.

▲ WARNING: The certification to the latest requirement such as FAR and JAR has to be conducted by the aircraft builder.

The following points should assist the aircraft builder at the choice of a suitable filter.

**Air filter:**

- ➪ four fold cotton fabric
- ➪ face covered with aluminium screen
- ➪ total filter area of at least 1400 $cm^2$ (220 $in^2$)

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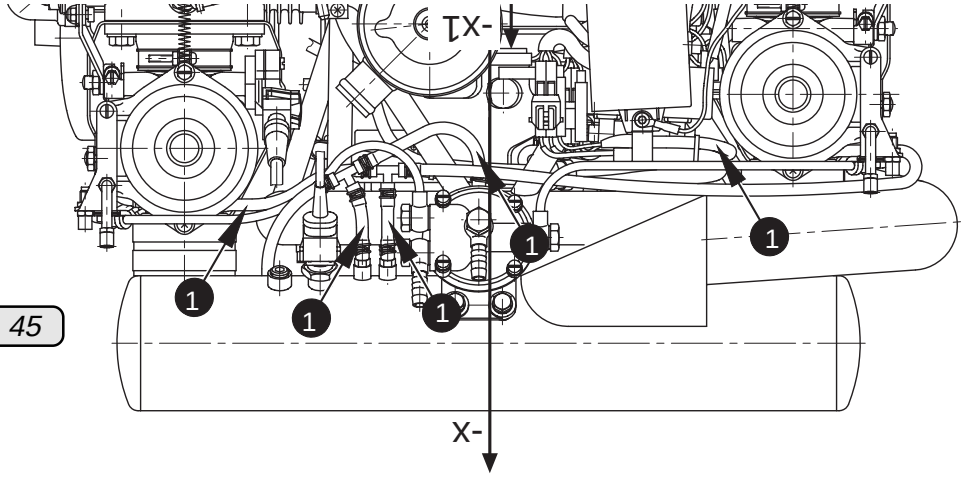
## 17) Pressure sensors

See Ill. 45/46.

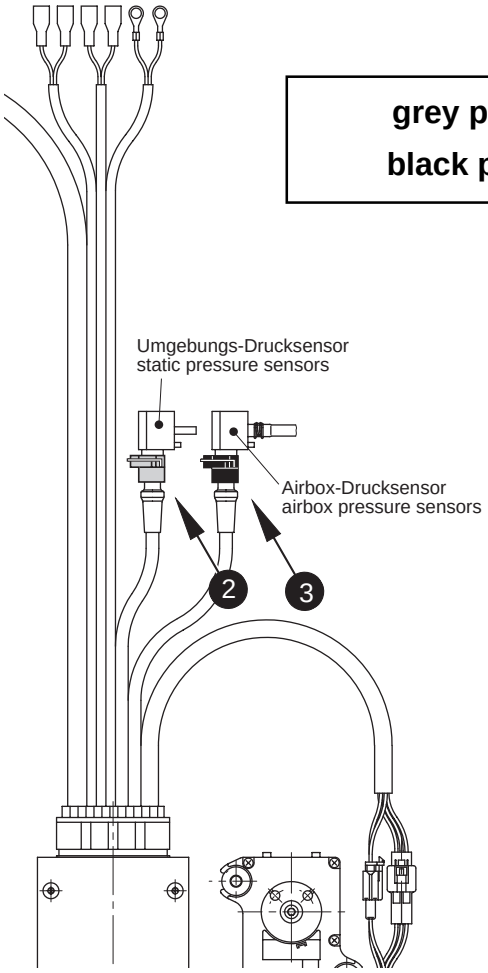
2 pressure sensors are included in the supply volume of the engine and connected by plugs with the wiring harness.

▲ WARNING: Since a failure of pressure interconnections ❶ of airbox, float chambers, fuel control and pressure sensor would possibly result in an engine stop all these interconnections have to made very carefully.




*Ill. 45*

◆ NOTE: To avoid any mix-up of pressure sensor wiring, plug connections are colour coded.




**grey plug connection ❷ ➪ static pressure sensor**
**black plug connection ❸ ➪ airbox pressure sensor**

*Ill. 46*

## 17.1) Static pressure sensor

See Ill. 47.

- effective range: 100 ÷ 1200 hPa
  deviation: max. ± 40 hPa
- operating temperature: min. - 40° C (-40° F)
  max. +125° C (257° F)
- dimensions and attachment: see sketch (Ill. 47)
- fitting position:

  The pressure connection (Pos. ❸ Ill. 47) points downwards to prevent possible condensate from entering the sensor, i.e. the longitudinal axis z4 has to be parallel to z-axis in system of coordinates.

  tolerated deviation of parallelism ± 60°
- location of installation:

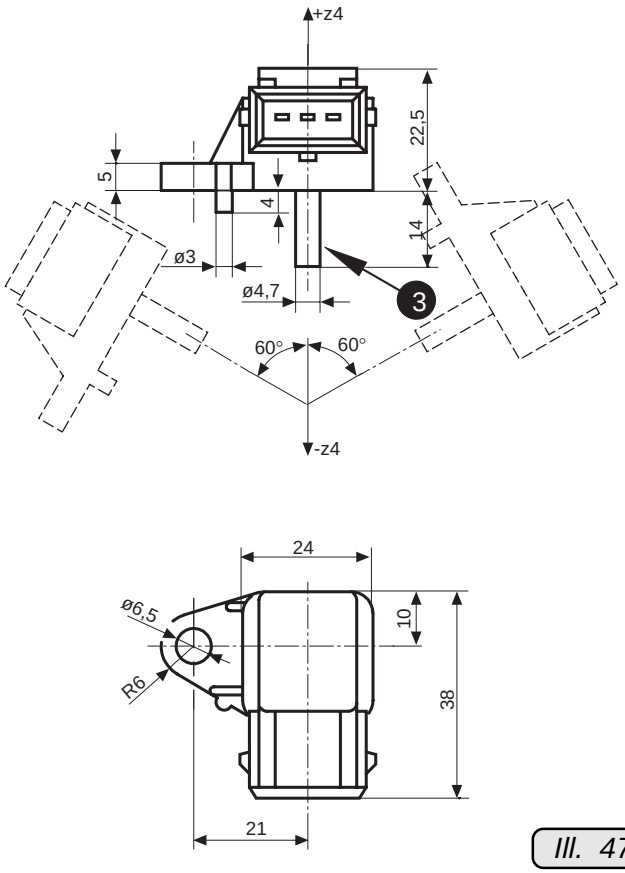
  vibration neutralized installation in a calm zone, e.g. in cockpit.

  In the area of the pressure pick-up approx. the same atmospheric pressure (static air pressure) has to prevail as at inlet of turbo charger.

■ ATTENTION: The pressure connection has to be protected against entering of foreign matter e.g. oil, fuel, water etc.

◆ NOTE: Location of installation is limited by the length of the wiring harness.

- length of cable assy.: approx. 250 mm (10 in) from TCU.




*Ill. 47*

## 17.2) Airbox pressure sensor

See Ill. 47.

- ➪ effective range: 500 ÷ 2500 hPa
  deviation: max. ± 60 hPa
- ➪ operating temperature: min. - 40° C (- 40° F)
  max. +125° C (257° F)
- ➪ dimensions and attachment: see sketch (Ill. 47)
- ➪ fitting position:

  The pressure connection (Pos. ❸ Ill. 47) points downwards to prevent possible condensate from entering the sensor, i.e. the longitudinal axis z4 has to be parallel to z-axis in system of coordinates.

  tolerated deviation of parallelism ± 60°
- ➪ location of installation:

  vibration neutralized installation

■ ATTENTION: The pressure connection has to be protected against entering of foreign matter e.g. oil, fuel, water etc. (see chapter 17.2.1).

◆ NOTE: Location of installation is limited by the length of the wiring harness.

- ➪ length of cable assy.: approx. 250 mm (10 in) from TCU.

### 17.2.1) Water trap

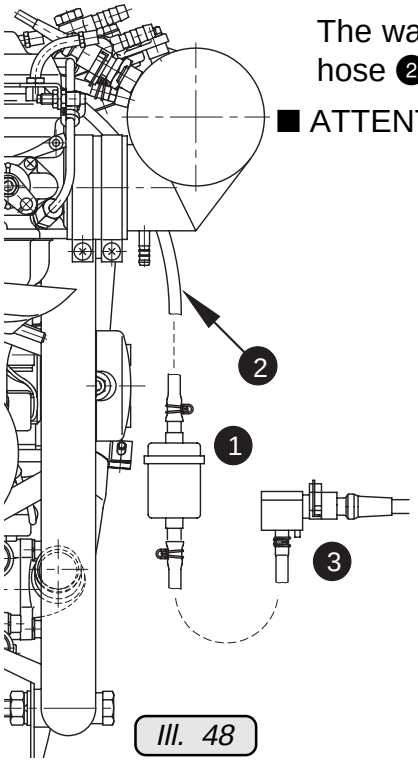
See Ill. 48/49.

Water trap is included in the supply volume of the engine.

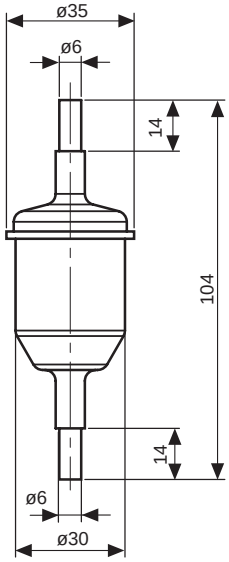
- ➪ dimensions and attachment: see sketch (Ill. 49)
- ➪ location of installation:

  The water trap ❶ has to be installed by clamps free of stress between hose ❷ 4x7 of airbox and the airbox pressure sensor ❸.

■ ATTENTION: Utilize full slip-on length on all connections.




*Ill. 48*



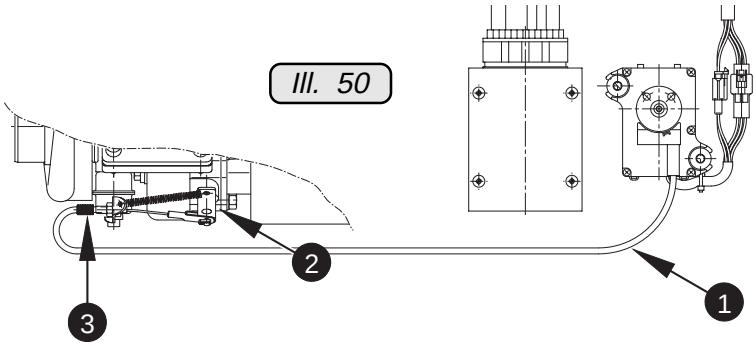

*Ill. 49*

## 18) Servo motor

See Ill. 50/51.

The correct adjustment of the servo cable ❶ and consequently the waste gate ❷ was made already on the course of the testrun at ROTAX.

*Ill. 50*




**Prior to engine operation check the position of the waste gate as follows:**

▲ WARNING: Engine stop - ignition "OFF".

➪ switch on TCU.

➪ servo motor runs with waste gate closed.

➪ slacken adjustment screw ❸ on servo cable support and turn adjustment screw until waste gate is completely closed.

➪ proper pretensioning of the servo cable is achieved by turning in the adjustment screw by one complete rotation.

Additionally, only the actual attaching of the servo motor has to be performed.

➪ operating temperature: min. - 20° C (- 4° F)
max. +60° C (140° F)

➪ dimensions and attachment: see sketch (Ill. 51)

➪ location of installation:
vibration neutralized place

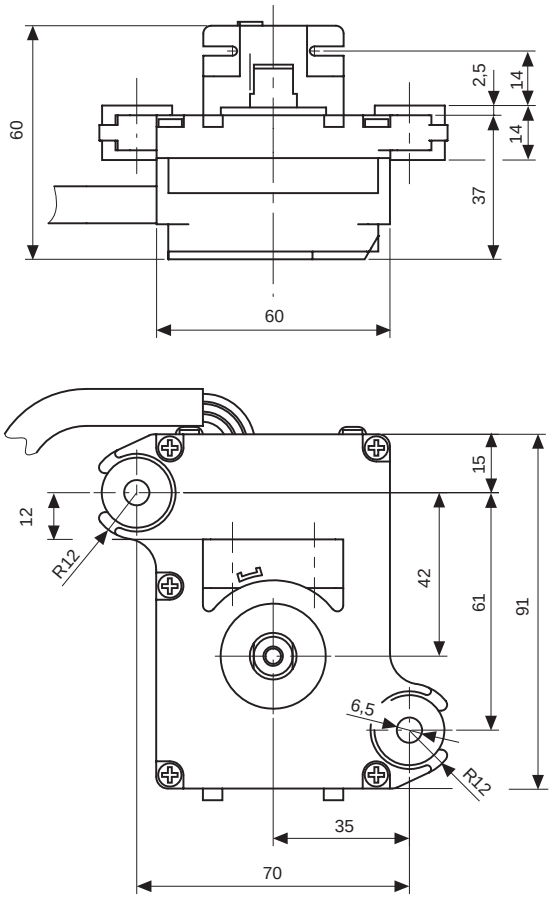
▲ **WARNING: Installation in the engine compartment is not permitted since the servo motor is not of a fire resistant construction.**

A recommendable location is in the cockpit below the instrument panel.

◆ NOTE: Place of installation is limited by the length of the servo cable.

➪ cable length: approx. 1000 mm (40") from waste gate

➪ bending radius: min. 50 mm (2")




*Ill. 51*

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## 19) Electric system

See Ill. 52.

The engine is supplied with the wiring completed and ready to operate. Only the following connections to the aircraft have to be established.

◆ NOTE: Throughout this documentation TCU stands for **T**urbo **C**ontrol **U**nit.

- integrated generator
- external rectifier-regulator
- electronic modules
- electric starter
- start relay
- 2 electric fuel pumps
- TCU
- isolating switch for servo motor
- 2 lamps (boost- and warning lamp)
- items conditional for operation like circuit breakers, ON-OFF switches, control lamps, relays, instrumentation and capacitors

**Optional extras**

- external alternator (as option if the output of the integrated generator is inadequate)
- electric rev-counter (accessory)

### 19.1) Requirements on circuit wiring

■ ATTENTION: The connections have to be completed by the aircraft builder in accordance to effective certification and wiring diagram (ill. 52).

The electromagnetic compatibility (EMC) and electromagnetic interference (EMI) is greatly affected by the wiring and has to be checked for each installation. Refer to chapter 19.1.1.

▲ WARNING: The supply to the various consumers (e.g. battery) has to be protected adequately by fuses (consult wiring diagram). Using fuses too large may result in damage to electric equipment.

Under no circumstances route consumers cables (e.g. battery) side by side with ignition cable. Induction could cause problems.

■ ATTENTION: An excess-voltage protection has to be realized by the aircraft builder in accordance to effective regulations.

▲ WARNING: The certification to the latest requirements such as FAR or JAR has to be conducted by the aircraft builder.

### 19.1.1) Electromagnetic compatibility (EMC)

The engine complies with the requirements of EMI and lighting protection as per standard RT CA DO-160C, sections 18, 20-22 and IEC 801-2.

The following EMC/EMI tests were performed:

- Radio frequency Susceptibility (conducted)
- Radio frequency Susceptibility (radiated)
- Audio Frequency Susceptibility
- Lightning Susceptibility
- Conducted RF Interference
- Radiated RF Interference

## 19.2) Wiring diagram

See Ill. 52.

**Legend to wiring diagram (Ill. 52)**

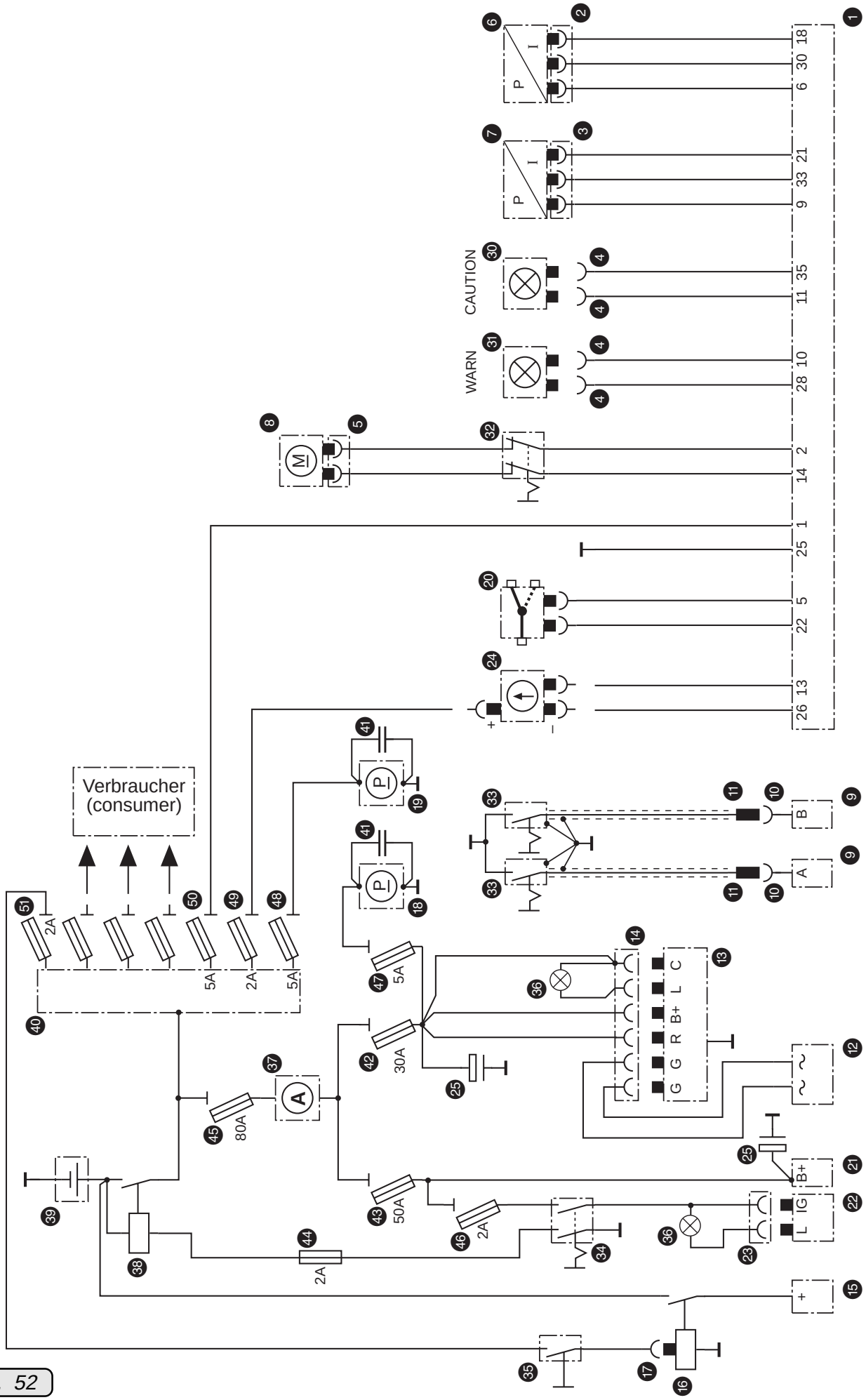
**Items 1-20** are included in the standard volume of supply of the engine

**Items 21-25** are available as accessory

**Items 30-51** can't be supplied

▲ WARNING: The certification of items/components which are not included in the standard volume of supply of engine has to be conducted by the aircraft builder to the latest requirements such as FAR or JAR.

| | |
|---|---|
| **1** | 36 pole plug receptacle |
| **2-3** | plug connection for pressure sensor |
| **4** | plug connection for lamps |
| **5** | plug connection for servo motor |
| **6** | pressure sensor (static pressure, atmospheric pressure) |
| **7** | pressure sensor (airbox) |
| **8** | servo motor |
| **9** | 2 electronic modules |
| **10-11** | plug connection for ignition switch |
| **12** | integrated generator |
| **13-14** | external regulator - rectifier with plug connections |
| **15** | electric starter |
| **16-17** | starter relay with plug connection |
| **18-19** | electric fuel pumps |
| **20** | 3-way solenoid valve (float valve pressure) |
| **21-23** | external alternator with connections |
| **24** | electric rev-counter |
| **25** | capacitor |
| **30-31** | lamps |
| **32** | isolating switch for servo motor |
| **33** | 2 ignition switches |
| **34** | master switch |
| **35** | starter switch |
| **36** | control lamp |
| **37** | amperemeter |
| **38** | battery relay |
| **39** | battery |
| **40** | bus bar |
| **41** | capacitor |
| **42-51** | circuit breaker |




*Ill. 52*

| Modification-No. | Reference | Install | Date | Page |
|---|---|---|---|---|
| - 0 - | | 914 F | 1996 05 10 | 75 |

## 19.3) Description of the Turbo Control Unit (TCU)

See Ill. 53/54.

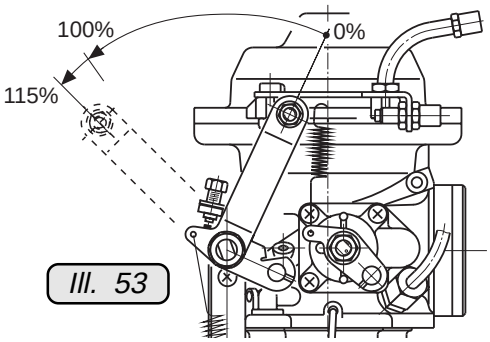
The ROTAX 914 F engine is equipped with an exhaust gas turbo charger, making use of the energy in the exhaust gas for precompression of the intake air (boost pressure).

The boost pressure in the airbox is controlled by means of an electronically controlled flap (waste gate) in the exhaust gas turbine.

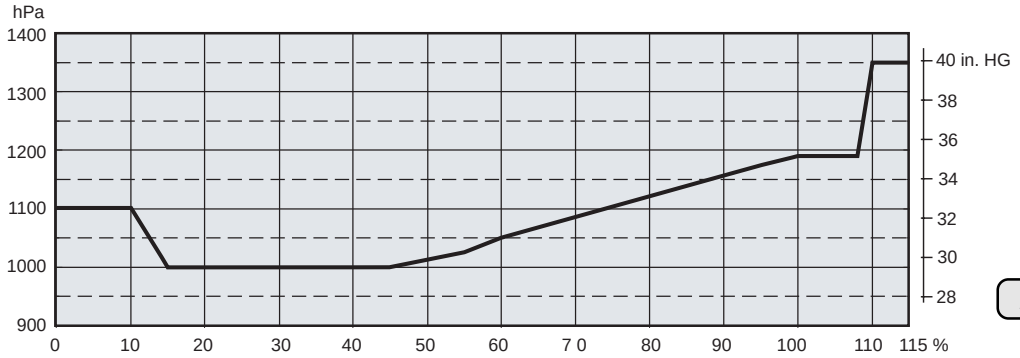
◆ NOTE: The waste gate regulates the speed of the turbo charger and consequently the boost pressure in the airbox.

The required nominal boost pressure in the airbox is determined by the throttle position sensor mounted on the carburetor 2/4. The sensor's transmitted position is linear from 0 to 115% corresponding to a throttle position from idle to full power. See ill. 53.

For correlation between throttle position and nominal boost pressure in the airbox, refer to the diagram (ill. 54).




*Ill. 53*




*Ill. 54*

The most important points for engine operation:

| engine performance | throttle position | nominal airbox pressure |
|---|---|---|
| idling of engine | ~ 0 % | 1100 hPa (32,5 in. HG) |
| max. continuous performance | 100 ÷ 108 % | 1190 hPa (35,1 in. HG) |
| take-off performance | 110 ÷ 115 % | 1350 hPa (39,9 in.HG) |

■ ATTENTION: As shown in the diagram, the throttle position at 108 ÷ 110 % results in a rapid rise of nominal boost pressure. To avoid unstable boost, the throttle should be moved speedily through this area either to full power (115 %) or, on a power reduction, to max. continuous power.

In this range (108 - 110 % throttle position) small changes in throttle position have a big effect on engine performance and speed, but are virtually not apparent for the pilot from the throttle lever position.

■ ATTENTION: The exact setting for a specific performance is virtually impossible in this range and has to be prevented, as it might cause control fluctuations (surging).

Besides the throttle position, overspeeding of the engine and too high intake air temperature have an effect on the nominal boost pressure.
If one of the stated factors exceeds the specified limits, the boost pressure is automatically reduced, thus protecting the engine against overload.

The TCU (Turbo Control Unit) is furnished additionally with output connections for an external **"red"** boost lamp and an **"orange"** caution lamp for indication of function of the TCU.

When switching on the voltage supply, the two lamps are automatically subject to a function test. Both lamps illuminate for 1 - 2 seconds, then they extinguish. If they do not, a check as per Maintenance Manual is necessary.

▲ **WARNING:** The engine must not be taken into operation before having corrected the cause of deficiency.

**Orange caution lamp:**

The non-illuminated orange caution lamp signals that TCU is ready for operation.

If the lamp is blinking, this indicates a malfunction of the TCU or its periphery.

**Red boost lamp:**

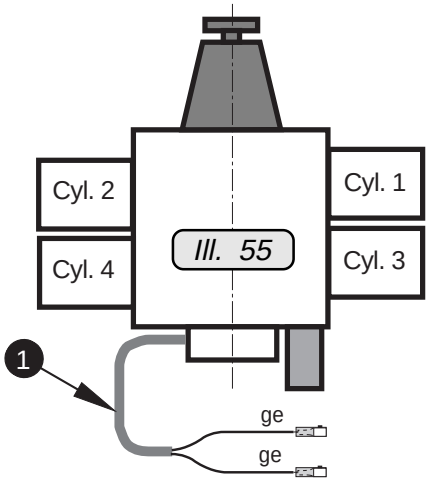
- ➪ Exceeding of the admissible boost pressure will activate the red boost lamp, being continuously illuminated.
- ➪ The TCU registers the time of full throttle operation (boost pressure). Full throttle operation for longer than 5 minutes will make the red boost lamp blinking

## 19.4) Technical data and connection of the electric components

### 19.4.1) Integrated generator

See Ill. 55

Feeding wires ❶ from the generator to rectifier-regulator on left side of ignition housing (see ill. 55).




*Ill. 55*

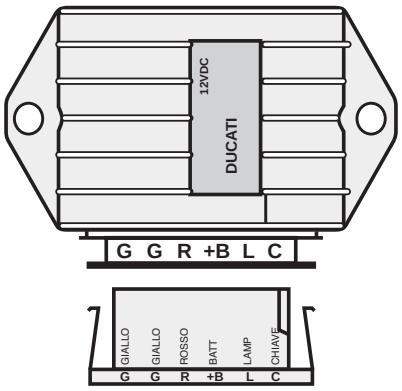
- ➪ 2 flexible cables, 1,5 mm² yellow (in shielding metal braid)
- ➪ length approx. 660 mm (26 in) starting from ignition housing
- ➪ with on each plug socket 6,3 x 0,8 to DIN 46247

◆ NOTE: approx. 250W AC output at 5800 r.p.m.

For DC output in connection with rectifier-regulator see chapter 19.4.2.

### 19.4.2) Rectifier-regulator

See Ill. 56/57.




*Ill. 56*

- ➪ type: electronic full-wave rectifier regulator
- ➪ effective voltage: 14 ± 0,3 V (from 1000 ± 250 r.p.m.)
- ➪ current limit: max. 28 A
- ➪ ambient
  temperature range: min. -25° C (- 13° F)
  max. +90° C (194° F)
- ➪ weight: 0,3 kg (.66 lb)

**Requirements for flawless operation of the rectifier-regulator**

- ➪ the rectifier-regulator has to be protected by a slow blowing 30A fuse.
- ➪ cross section of the main circuit of at least 2,5 mm²
- ➪ a capacitor (Ill. 52 Pos.㉕) of at least 22 000 µF / 25 V is necessary.
- ➪ the voltage difference between battery and terminal **C** of regulator should be less than 0,2 V.

  Use cables in this area as short as possible and with adequate cross section.
- ➪ never sever connection between terminal **C** and **+B** of regulator e.g. by removal of a fuse

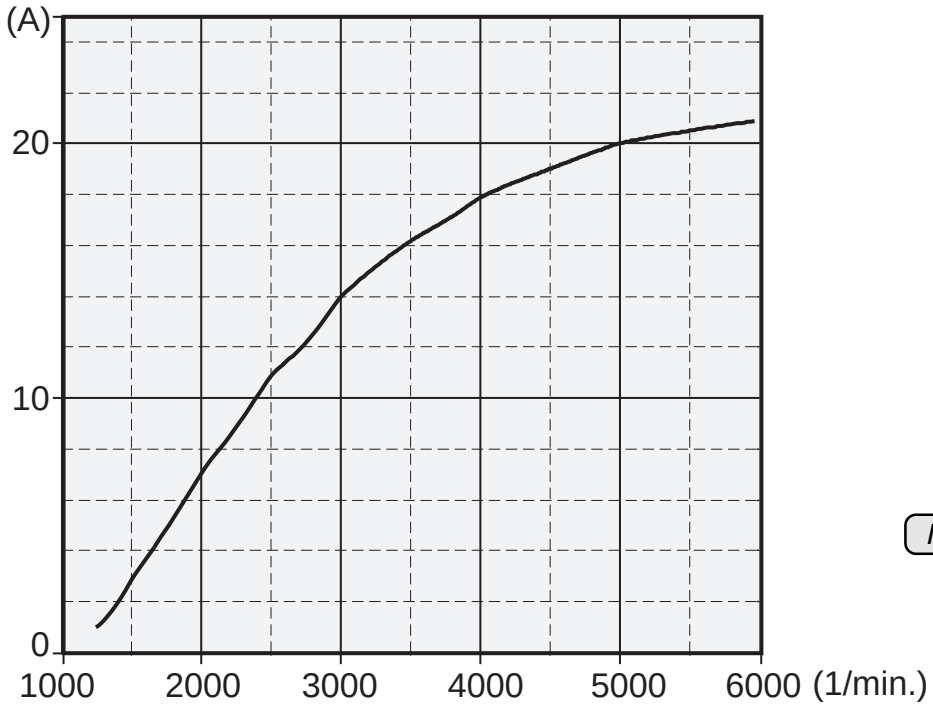
➪ Current:

■ ATTENTION: The graph current over engine speed has been determined and is valid only at the following conditions.

ambient temperature: ..... 20 °C (68° F)

voltage: ..... permanent 13,5 V

tolerance: ..... max ± 5%




*Ill. 57*

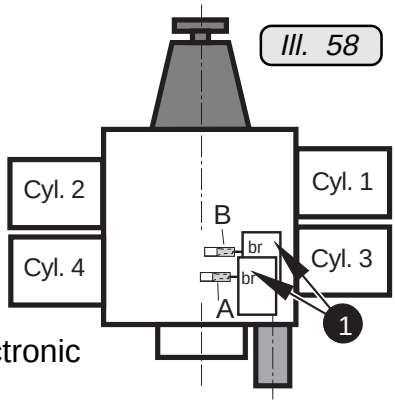
◆ NOTE: A charge-indicating lamp 3W/12V (Ill. 52, pos. ㊱) may be fitted on the instrument panel.

### 19.4.3) Electronic modules

See Ill. 4/58.

Ambient temp. for the electronic modules ❶: ..... max. 80°C (176°F).

### 19.4.4) Ignition switches (on-off switch)




See Ill. 58.

- ➪ type: two separate, suitable on-off switches (Ill. 52, pos. ㉝)
- ➪ switching voltage: min. 250 V
- ➪ switching current: min. 0,5 A

Feeding lines to on-off switches on the electronic module (see Ill. 58).

- ➪ 1 each flexible cable 0,75 mm², brown

  length approx. 35 mm (1 3/8") beginning at electronic module with one each plug socket and insulating sleeve 3,96 mm.

◆ NOTE: One each plug and insulating sleeve are supplied loosely packed.

- ➪ shorting cable of top electronic module (marked "A") for ignition circuit A. Shorting cable of bottom electronic module (marked "B") for ignition circuit B.

◆ NOTE: Ignition circuit A controls: top spark plugs of cylinders

Ignition circuit B controls: lower spark plugs of cylinders

■ ATTENTION: The electromagnetic compatibility (EMC) and electromagnetic interference (EMI) depends essentially on the shorting cables used.

Min. section area: 2x 0,75 mm² (shielded flexible cable, shielding braid on both ends grounded).

■ ATTENTION: The metal base of each ignition switch must be grounded to air craft frame.

### 19.4.5) Electric starter

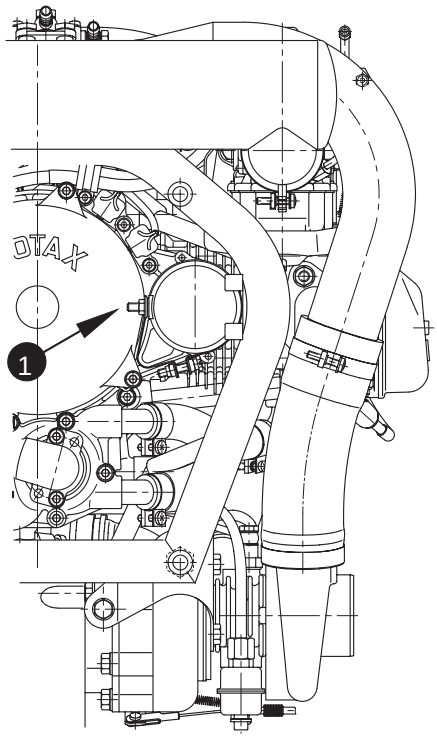
See Ill. 59.

Feeding lines from starter relay to the electric starter

- ➪ cross section of at least 16 mm²
- ➪ output: .6 kW
- ➪ plus terminal ❶: M6 screw (tightening torque 8 Nm (70 in.lb)) suitable for cable eyes to DIN 46225
- ➪ grounding: via engine block

■ ATTENTION: Suitable for short starting periods only.

Activate starter for max. 10 sec. without interruption, followed by a cooling period of 2 min!



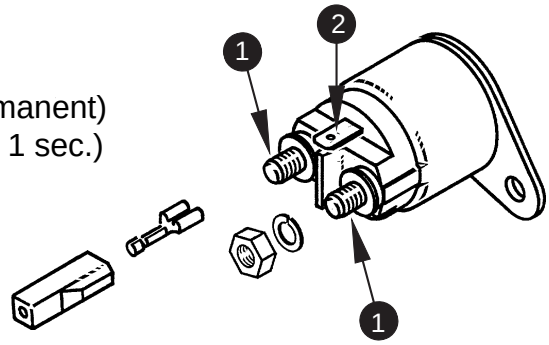

*Ill. 59*

### 19.4.6) Starter relay

See Ill. 60.

- ➪ nominal voltage: 12 V
- ➪ control voltage: min. 6 V
  max. 18 V
- ➪ switching current: max. 75 A (permanent)
  max. 300 A (for 1 sec.)
- ➪ ambient temperature range:
  from – 40° C (-40° F) to
  +100° C (214° F)
- ➪ weight: 0,145 kg (.32 lb)

*Ill. 60*




- ➪ current connections ❶: M6 screw (tightening torque 8 Nm (70 in.lb)) suitable for cable eyes to DIN 46247
- ➪ control wiring ❷: plug connector 6,3x0,8 suitable for plug socket to DIN 46247
- ➪ grounding: via housing

■ ATTENTION: Activation of start relay limited to short duration. Over a period of 4 min. operation, the duty cycle is 25%.

### 19.4.7) Electric fuel pumps

See Ill. 61/62.

- ➪ installation: see fuel system, chapter 14
- ➪ voltage: 12 V/DC
- ➪ connections: **+** terminal: M 4 screw connection
  **–** terminal: M 5 screw connection

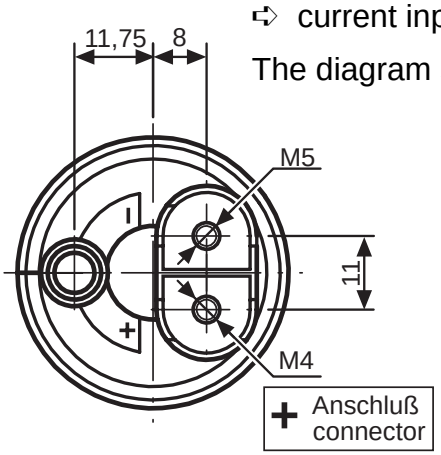
  suitable for cable eyes to DIN 46225

For radio interference suppression a capacitor (Ill. 52 Pos.) of 1µF / 100 V has to fitted as near as possible to the terminals.

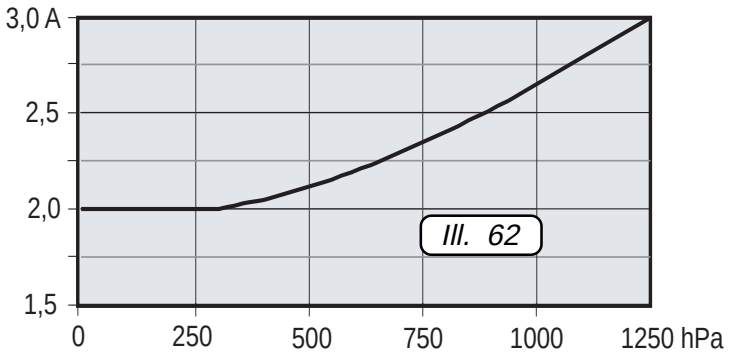
▲ WARNING: The certification to the latest requirements such as FAR or JAR has to be conducted by the aircraft builder.

- ➪ current input:

The diagram shows the current input over pressure.




*Ill. 61*




Take note of the following:

- ➪ The diagram outlines minimum capacity at nominal voltage on pump.
- ➪ Pressure- and suction head are "ZERO".
- ➪ Graph is effective on a seasoned pump only, running-in period approx. 30 min.
- ➪ Fuse:

  Each of the two fuel pumps has to be protected by y slow blowing 5A fuse in accordance with wiring diagram (Ill. 52).

▲ WARNING: All connections have to be established by the aircraft builder in compliance with regulations such as FAR or JAR and the effective wiring diagram (Ill. 52).

▲ WARNING: An essential point is according to regulations, that the fuel pumps are connected on two completely independent power supplies.

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### 19.4.8) Turbo Control Unit (TCU)

See Ill. 63.

➪ voltage: 12 V/DC min. 6 V
max. 18 V

➪ current input: see chapter 19.5.

◆ NOTE: At wrong polarity of the supply voltage both lamps will light up.

➪ operating temperature range: min. - 25° C (-13° F)
max. +70° C (+160° F)

➪ storage temperature range: min. - 40° C (-40° F)
max. +70° C (+160° F)

➪ weight: approx. 425 g (1 lb)

➪ dimensions and attachment: see sketch (Ill. 63)

➪ place of installation:

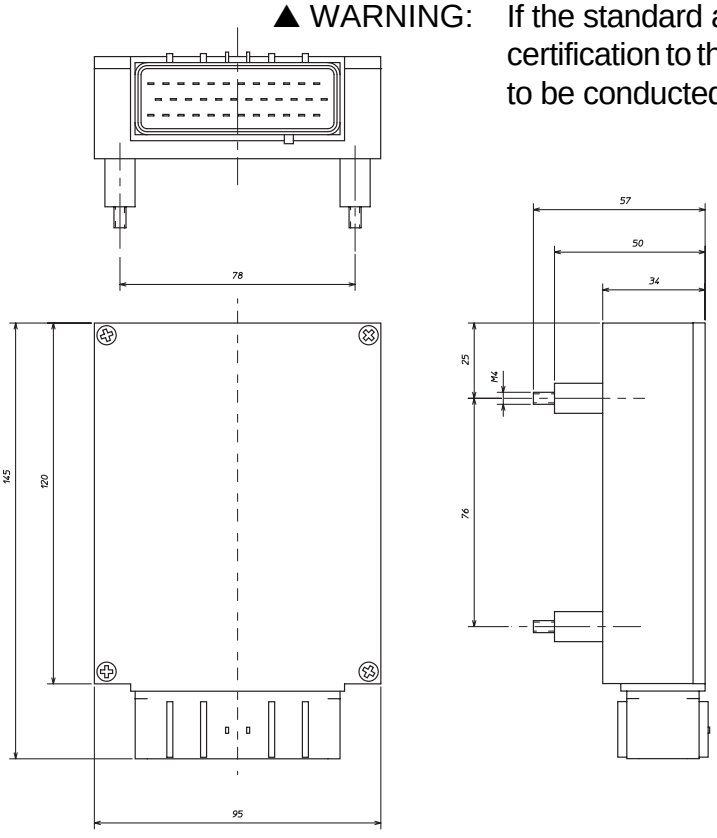
▲ WARNING: **Installation in the engine compartment is not permitted since the TCU is not of a fire resistant construction.**

A recommendable location is in the cockpit, below the instrument panel.

◆ NOTE: Place of installation is limited by the length of the wiring harness.

Support of the TCU on the 4 silent blocks which ensures an attachment free of vibrations.

▲ WARNING: If the standard attachment should not be utilized or changed, certification to the latest requirements such as FAR or JAR has to be conducted by the aircraft builder.




*Ill. 63*

▲ WARNING: Choose place of installation such, that operation is within the specified temperature limits.

▲ WARNING: The TCU comprises electronic components and is therefore completely sealed. **The TCU is allowed to be opened only by persons authorized by BOMBARDIER-ROTAX!**

➪ connections: **+** terminal: flexible cable 0,75 $mm^2$ white No. 1*
**–** terminal: flexible cable 0,75 $mm^2$ white No. 25*

* from the 36 pole plug receptacle of the TCU with cable eye 4,2 mm dia. to DIN 46225

➪ fuse:

The TCU has to be protected by a slow blowing 5A fuse in accordance with the wiring diagram, Ill. 52.

### 19.4.9) Isolating switch for servo motor

See Ill. 52.

The isolating switch serves to break the circuit of the servo motor for a short time in case of surging of the TCU.

After a short hunting stable operation should follow.

➪ design: 2 pole on-off switch (Ill. 52 Pos.)

■ ATTENTION: The isolating switch has to be designed such that it is safe for "off" by mistake or unintentionally. The fix and secured position is **"ON"**.

➪ switching voltage: min. 100 V

➪ switching current: min. 2 A

➪ place of installation:

On the instrument panel in the pilot's field of view, anytime and easy to reach.

**<u>Installation instruction:</u>**

The isolating switch has to be installed directly into the lines from 36 pole plug receptacle to servo motor.

■ ATTENTION: The servo motor is connected to DC supply. The polarity (wire 2 and 14) of the cables must not be changed, otherwise the sense of rotation would be reversed and control would be rendered ineffective.

To avoid any mix-up of the polarity sever first one cable and connect on switch as per wiring diagram (Ill. 52).

After first cable is connected sever second wire and connect also to switch.

### 19.4.10) Warning light

See Ill. 52.

- colour of lamp: **red** or colour as per effective regulations.
- voltage: 12 V(DC)
  depending on input voltage of TCU.
- current: max. 0,5 A
- connections: **+** terminal: flexible cable 0,75 $mm^2$ white No. 10*
  **–** terminal: flexible cable 0,75 $mm^2$ white No. 28*

  * from the 36 pole plug receptacle of the TCU, plug 6,3 x 0,8 to DIN 46247
- length approx. 600 mm (24 in) from TCU

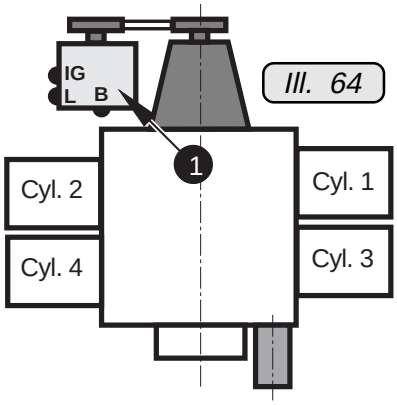
### 19.4.11) Caution light

See Ill. 52.

- Colour of lamp: **orange** or colour as per effective regulations.
- Voltage: 12 V(DC)
  depending on input voltage of the TCU
- current: max. 0,5 A
- connections: **+** terminal: flexible cable 0,75 $mm^2$ white No. 11*
  **–** terminal: flexible cable 0,75 $mm^2$ white No. 35*

  * from the 36 pole plug receptacle of the TCU, plug 6,3 x 0,8 to DIN 46247
- length approx. 600 mm (24 in) from TCU

### 19.4.12) External alternator (optional extra)



*Ill. 64*

See Ill. 64/65/66.

- output: max. 600 W DC at 6000 r.p.m.
- voltage: 14,2 – 14,8 V
- ambient
  temperature range: min. - 30° C (-22° F)
  max. +90° C (194° F)

◆ NOTE: Voltage regulator is integrated in the generator

Feeding wiring to external alternator ❶ located on the outside of propeller gear (see ill. 64).

- plus terminal ❷: M6 screw suitable for cable eyes to DIN 46225 (tightening torque 8 Nm (70 in.lb))
- grounding: via engine block
- control wiring ❸: via supplied standard plug (Sumitomo 6111-2568)

**Requirements for flawless operation of the integrated rectifier-regulator**

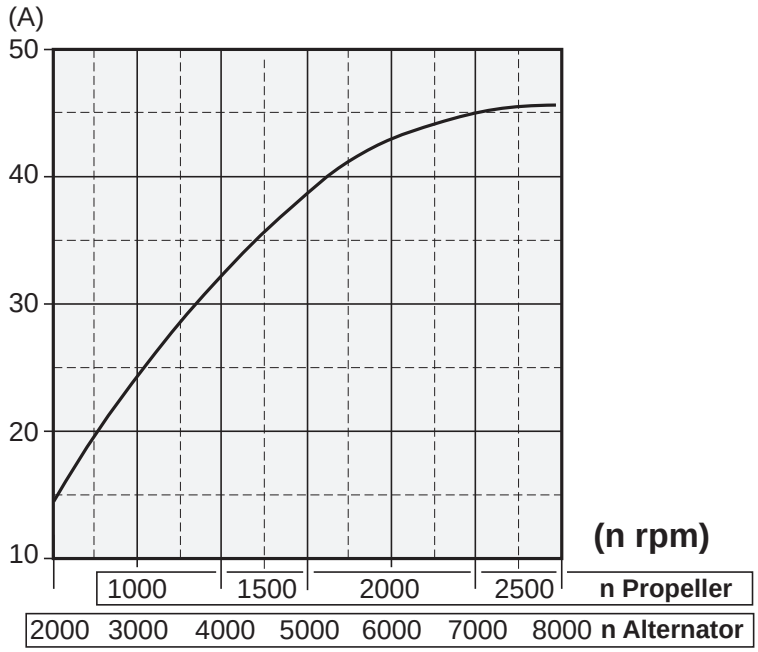
- the rectifier-regulator has to be protected by a slow blowing 50A fuse
- cross section of the main circuit at least 4 $mm^2$
- a capacitor (Ill. 52 Pos.㉕) of at least 22 000 µF / 25 V is necessary
- current:

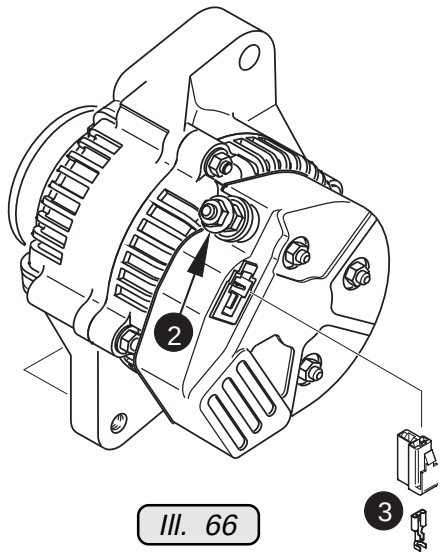
■ ATTENTION: The current over speed graph has been determined and is effective only at the following conditions:

ambient temperature: 20 °C (68° F)

voltage: permanent 13,5 V

tolerance: ± 5%



*Ill. 66*

*Ill. 65*

◆ NOTE: The speed of the auxiliary generator is 1,24 times crankshaft speed or 3 times the prop speed.

### 19.4.13) Connection of the electric rev-counter

See Ill. 52/67.

Feeding wiring to electric rev-counter from the 36 pole receptacle of TCU.

➪ connections: flexible cable 0,75 mm² white No. 26*
flexible cable 0,75 mm² white No. 13*

* from the 36 plug receptacle of TCU without plug connection

➪ length approx. 1000 mm (40 in) from TCU.

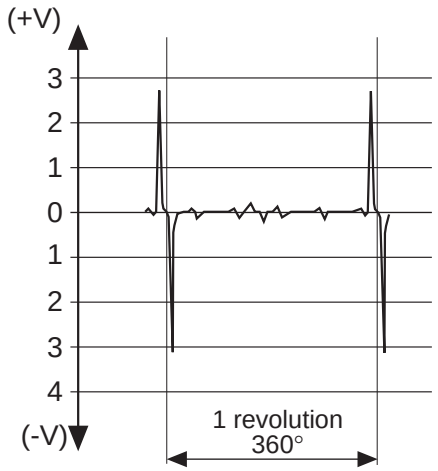
◆ NOTE: BOMBARDIER-ROTAX developed especially for this application a non-certified electric rev-counter. Certification to the latest requirements such as FAR or JAR has to be conducted by the aircraft builder.

■ ATTENTION: The graphs depicting output signals have been determined and are effective only at the following conditions.

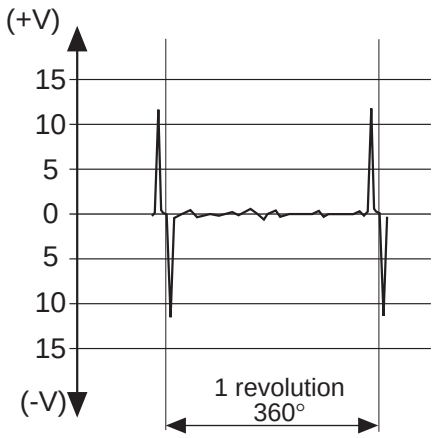
ambient temperature: 20° C (68° F)
tolerance: ± 5%

The pick-up for the rev-counter generates one pulse per revolution. Pulse shape and pulse voltage as per recordings (oscillogram).

**speed 500 rpm (load 100 Ω)**

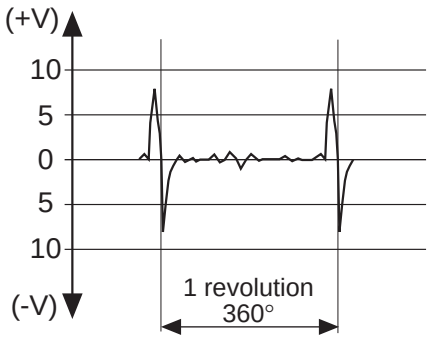



**speed 500 rpm (load 100 kΩ)**

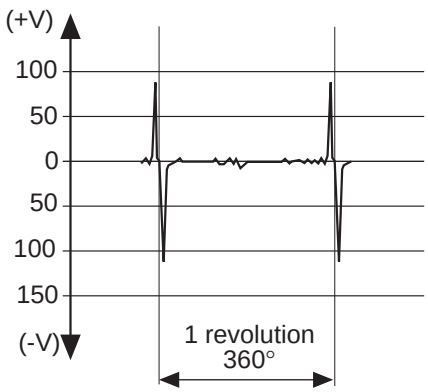



*Ill. 67*

**speed 6000 rpm (load 100 Ω)**




**speed 6000 rpm (load 100 kΩ)**



### 19.4.14) Battery

See Ill. 52.

■ ATTENTION: To warrant reliable engine start use a battery of at least 16 Ah capacity.

## 19.5) Internal consumer of electric power

▲ WARNING: The power consumption of extra users has to be limited to the extent that the internal need of power, e.g. for fuel pumps is always covered.

Refer to graph, current output over speed of the integrated generator and the external alternator.

| item | current consumption |
|---|---|
| fuel pump (main) ..... | max. 3 A |
| fuel pump (stand by) ..... | max. 3 A |
| TCU (1 ..... | max. 0,3 A |
| servo motor ..... | max. 1 A |
| warning lamp (2 ..... | approx.0,25 A |
| caution lamp (2 ..... | approx.0,25 A |
| **sum (3 .....** | **~ 8 A** |

(1 internal power consumption, without servo motor and lamps

(2 standard value, actual value up to aircraft builder

(3 without electric starter and start relay

## 20) Propeller drive

The propeller in tractor-or pusher arrangement has to be fitted on the propeller flange in accordance to current certification. As required utilize one of the three possible pitch circle diameters (P.C.D.) on the flange.

Certification of the propeller sizing and arrangement to the latest requirement such as FAR or JAR has to be conducted by the aircraft builder.

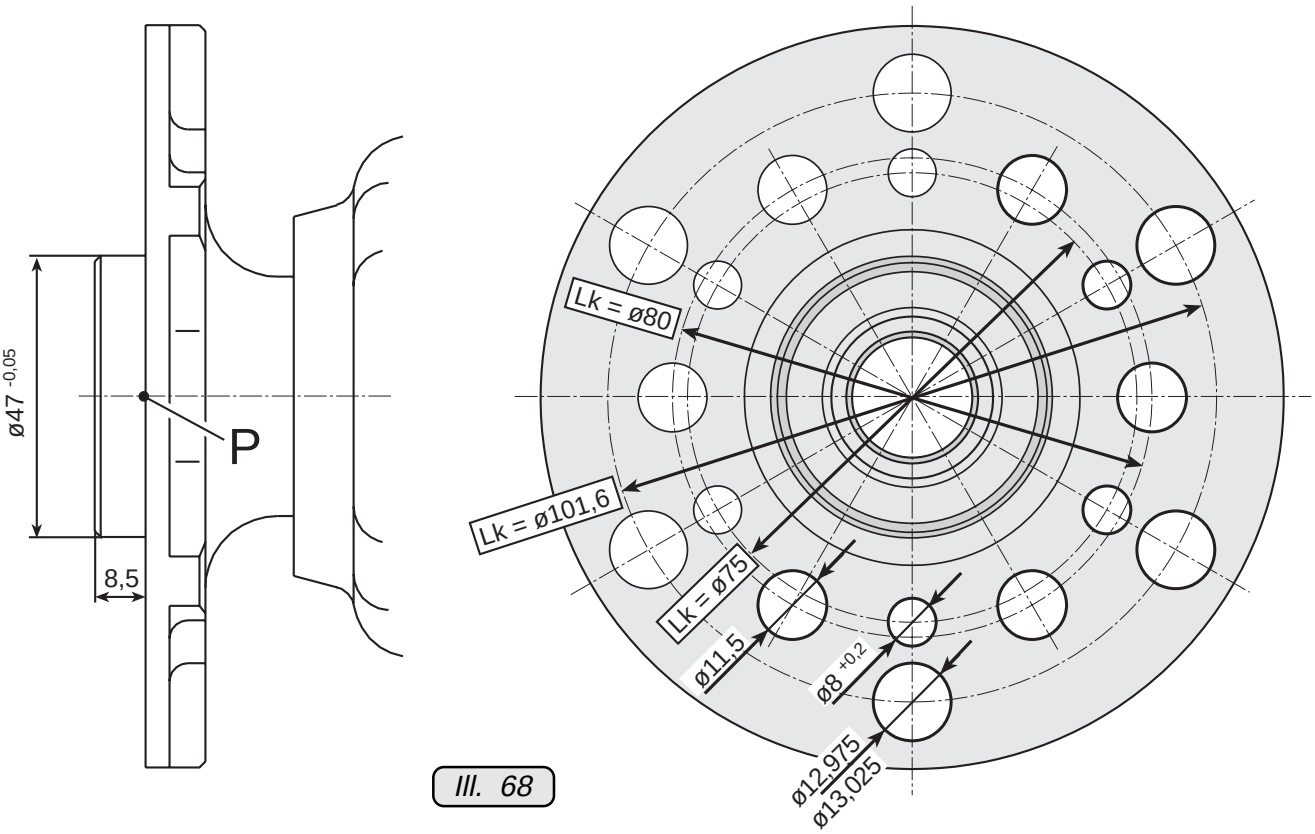
▲ WARNING: Never run the engine without a propeller installed as engine would suffer severe damage by overspeeding.

Never fit propeller directly on crankshaft.

### 20.1) Technical data:

See illustration 68.

- direction of rotation of the prop flange: counter clockwise, looking towards face of flange
- location: see system of coordinates
- attachment of propeller on prop shaft flange:
  - P.C.D 75 mm (2,95"): 6 bolt holes of 8 mm dia
  - P.C.D 80 mm (3,15"): 6 bolt holes of 11,5 mm dia
  - P.C.D 101,6 mm (4"): 6 bolt holes of 13 mm dia.
- ratio of gear reduction: 2,4286 (51 T/21 T)
- max. torque: 340 Nm (103 ft.lb.) at propeller
- max. moment of inertia : 6000 kgcm$^2$
- max. permitted out-of-balance on a prop: max. 0,5 gm




*Ill. 68*

# 21) Vacuum pump

## 21.1) Technical data:

See Ill. 69.

Type: Airborne 211 CC, drive via propeller gear

➪ location of the necessary connection ❶ and ❷ on the vacuum pump

| | AxisAchsen | | |
|---|---|---|---|
| Connections | x axis | y axis | z axis |
| 1 | 226 | 0 | 98 |
| 2 | 293 | 0 | 98 |

➪ connections

thread size: 5/8“ 16 T.P.I.
tightening torque: hand tight and tighten up by max. 1,5 turn with ring spanner.

Effective thread length: max. 17 mm (9/16")

➪ net weight: 0,8 kg (1 $^{3}/_{4}$ lb)

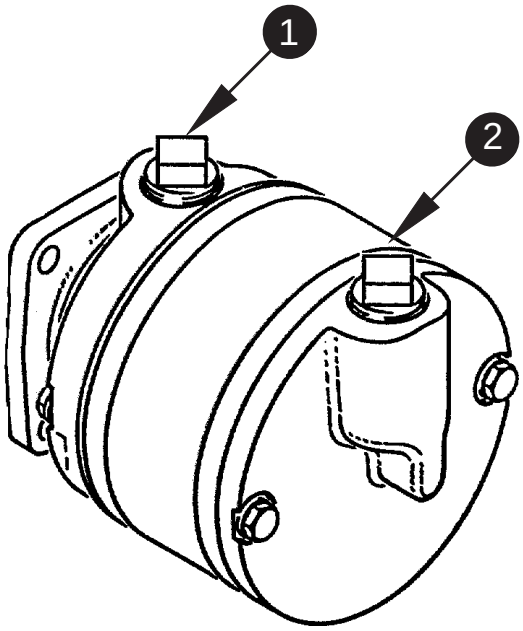
➪ power input: max. 300 W

➪ delivery rate: max. 0,165 dm³ (10 m³) per minute at 0,65 bar (10 p.s.i) as from 1900 r.p.m pump speed.

■ ATTENTION: Pay attention to manufacturer's specifications

◆ NOTE: Speed reduction from crankshaft to vacuum pump is 1,842, i.e. the vacuum pump runs with 0,54 of engine speed.

▲ WARNING: Certification to the latest requirements such as FAR or JAR has to be conducted by the aircraft builder.




*Ill. 69*

## 22) Hydraulic governor for constant speed propeller

### 22.1) Technical data:

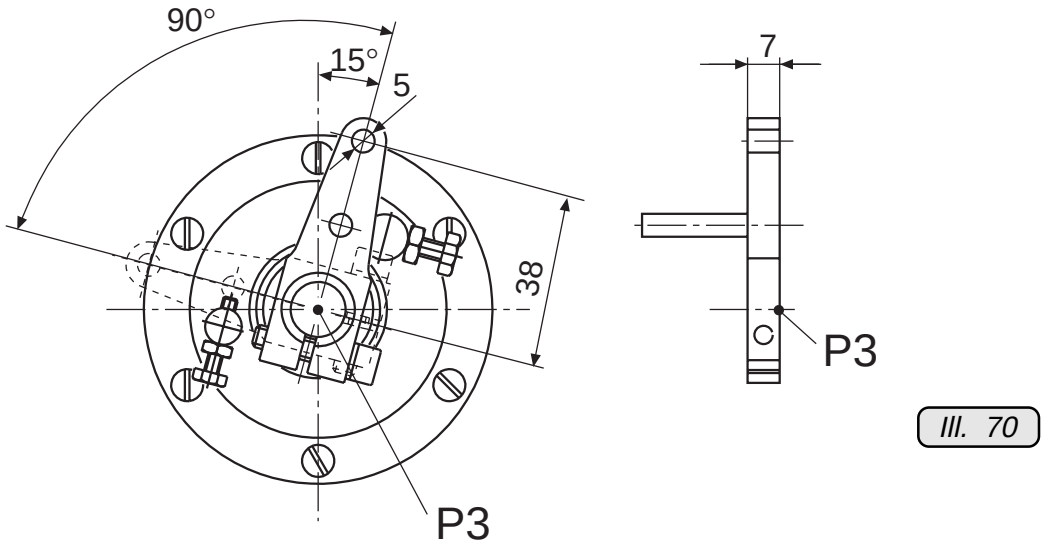
See Ill. 70

Type: Woodward governor A210786 (for engine type F3 only), drive via prop gear

Location of centre of connection (P3):

| | Axes | | |
|---|---|---|---|
| Centre P3 | x axis | y axis | z axis |
| | -373 | -10 | 51 |

- cable connection: see ill. 70
- cable travel: approx. 54 mm (2 1/8")




*Ill. 70*

- actuating force: approx. 3 N (during operation at max. speed) (.67 lb)
  limit load 6 N (1,35 lb)
- power input: max. 600 W
- operating pressure: max. 30 bar (435 p.s.i.)
- weight: 1,44 kg (3,2 lb)
  2,7 kg (6 lb) (inclusive drive unit)

◆ NOTE: Reduction ratio of crankshaft to governor is 1,842 e.g. the governor speed is 0,54 of the engine speed.

## 23) Connections for instrumentation

These connections to be established in accordance to certification and/or national specifications.

The certification for connections and connection lines have to be conducted by the aircraft builder to the latest requirements like FAR and JAR.

For notes regarding the electric rev-counter consult the chapter 19.4.13.

### 23.1) Sensor for cylinder head temperature:

See Ill. 71/72.

◆ NOTE: A direct reading of the coolant temperature is not provided for.

The temperature sensor ❶ is directly fitted into cylinder head i.e. a direct temperature reading of the cylinder head material is taken. This allows the exact measuring of the cylinder head temperature even in the case of coolant loss.

◆ NOTE: Readings are taken on the hottest cylinder, depending on engine installation.

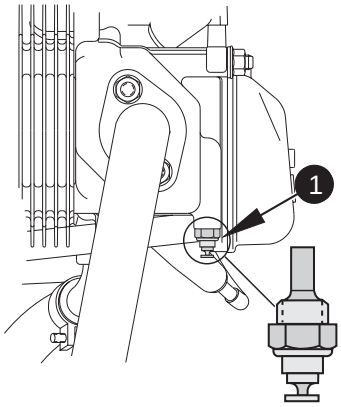
➪ location: in the cylinder head of the cylinders 2 and 3, see Ill. 4.

➪ connection: plug for socket 6,3x0,8 to DIN 46247

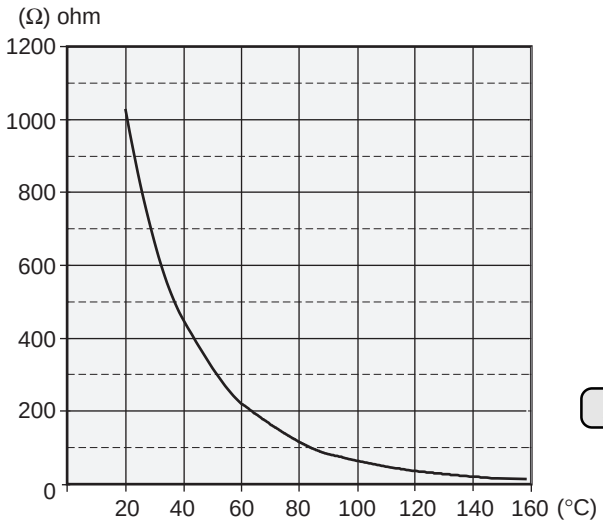
| | Axes | | |
|---|---|---|---|
| cylinder head | x axis | y axis | z axis |
| 2 | -200,0 | 241,0 | -157,0 |
| 3 | -387,0 | -241,0 | -157,0 |

➪ grounding: via engine block

➪ graph of sensor resistance over temperature




*Ill. 71*




*Ill. 72*

■ ATTENTION: The graph resistance over temperature has been determined, and is effective at the following conditions only.

ambient temperature: 20° C (68° F)
tolerance: ± 10%

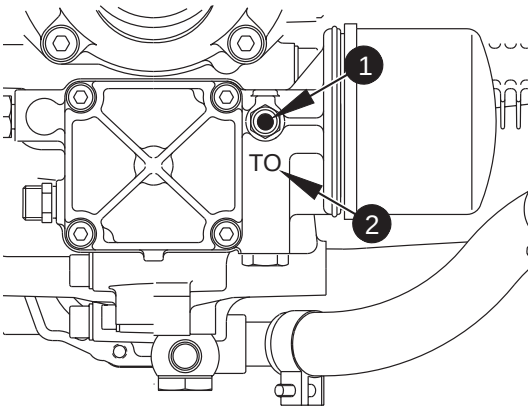
◆ NOTE: BOMBARDIER-ROTAX recommends the temperature indication VDO instrument “VDO 310.274/082/017“ with an indicating range of 50° to 150° C (120° F - 300° F).

## 23.2) Sensor for oil temperature:

See Ill. 73/74

➪ location: oil pump housing

➪ marking ❷: marked with "TO" on oil pump flange




*Ill. 73*

■ ATTENTION:

To avoid any mix-up with indication wiring, mark this particular cable also with "TO".

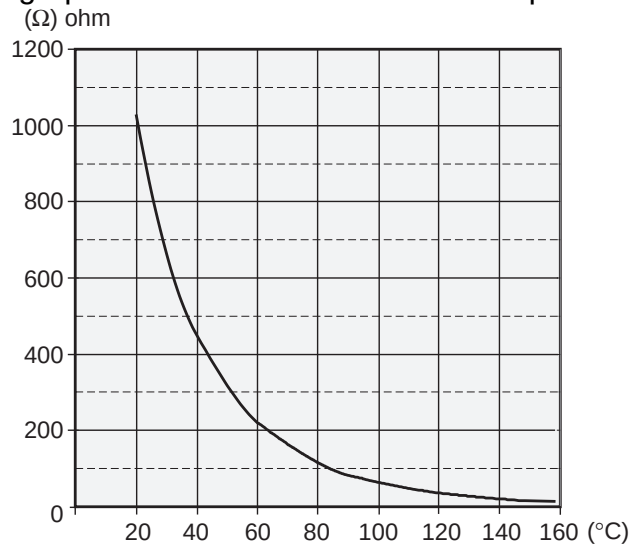
➪ position of the temperature sensor ❶ on the oil pump flange:

| | Axes | | |
|---|---|---|---|
| point of support | x axis | y axis | z axis |
| | -115 | 46 | -150 |

➪ connection of sensor wiring: plug for socket 6,3 x 0,8 to DIN 46247

➪ grounding: via engine block

➪ graph of sensor resistance over temperature




*Ill. 74*

■ ATTENTION: The graph resistance over temperature has been determined, and is effective at the following conditions only.

ambient temperature: 20° C (68° F)
tolerance: ± 10%

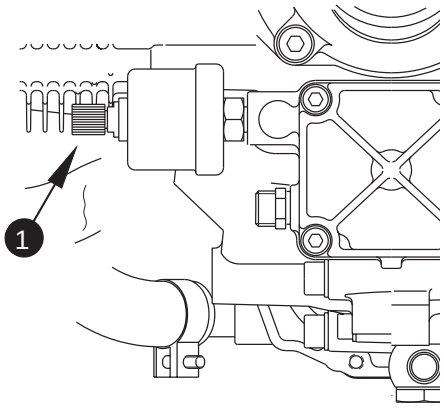
BOMBARDIER-ROTAX offers a non-certified temperature indicating instrument. Refer to current spare parts list.

▲ WARNING: Certification to the latest requirements such as FAR of JAR has to be conducted by the aircraft builder.

## 23.3) Oil pressure sensor

See Ill. 75/76.

➪ location: oil pump housing




*Ill. 75*

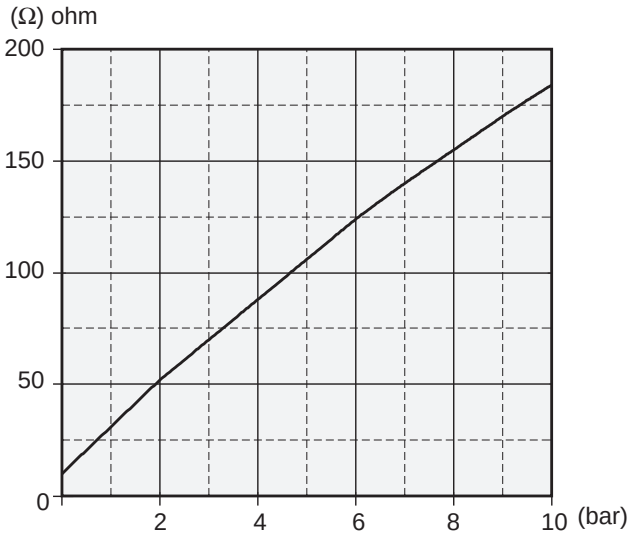
➪ position of connection on oil pressure pick-up ❶:

| | Axes | | |
|---|---|---|---|
| point of connection | x axis | y axis | z axis |
| | ca. -100 | 7 5 | ca. -150 |

➪ connection of pick-up wiring: single pole screw connection for cable eye 3 to DIN 46225

➪ grounding: via engine block

➪ graph of resistance over pressure




*Ill. 76*

■ ATTENTION: The graph resistance over pressure has been determined, and is effective at the following conditions only.

ambient temperature: 20° C (68° F)
voltage: 12 V
tolerance: ± 5%

BOMBARDIER-ROTAX offers a non-certified pressure gauge. Refer to current spare parts list.

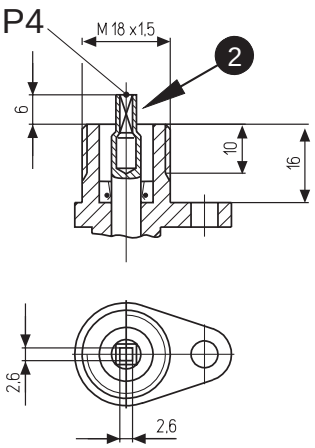
▲ WARNING: Certification to the latest requirements such as FAR of JAR has to be conducted by the aircraft builder.

## 23.4) Mechanical rev-counter or hour-meter:

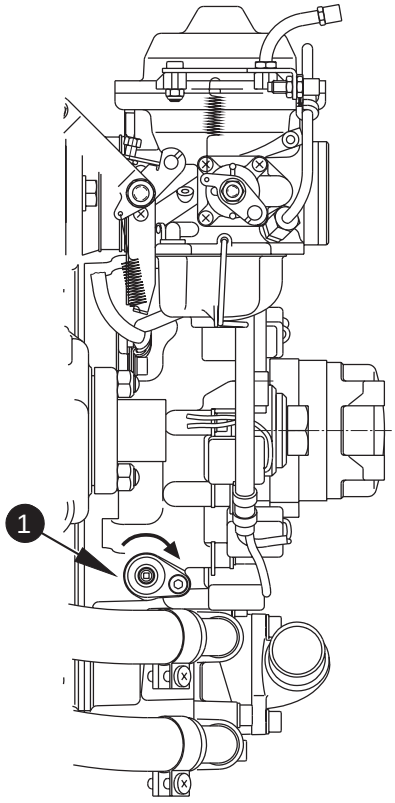
See Ill. 77/78.

- location: ignition housing ❶
- direction of rotation of the rev-counter shaft ❷: clockwise, see illustration
- position of rev-counter drive:

| | Axes | | |
|---|---|---|---|
| point of engagement P4 | x axis | y axis | z axis |
| | -465 | 87 | -160 |




*Ill. 78*




*Ill. 77*

- installation dimensions: see illustration
- reduction ratio: i = 4 i.e. 1/4 of engine speed

◆ NOTE: A flexible shaft for the mechanical rev-counter is readily available from BOMBARDIER-ROTAX.

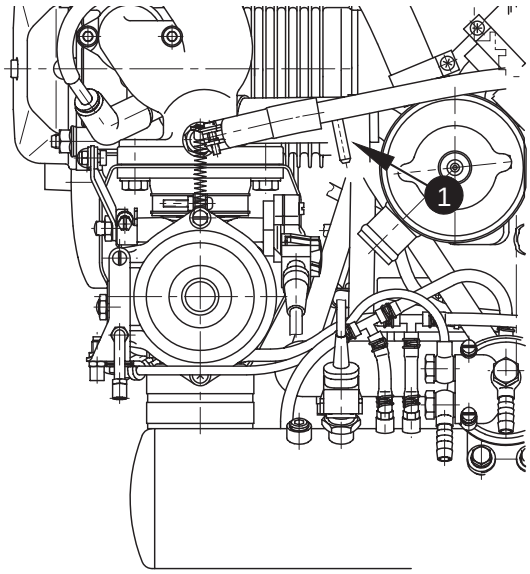
## 23.5) Monitoring of the intake manifold pressure

See Ill. 79.

**Connection nipple ❶ to measure manifold pressure:**

outside dia. ø ..... 6 mm (1/4")
slip-on length . max. 17 mm (11/16")

■ ATTENTION: Utilize the total slip-on length on all joints. Secure hose by suitable screw clamps or crimp connection.




▲ WARNING:

Protective covering to be utilized for transport and at engine installation only. If connection for pressure reading is not employed it has to plugged suitably.

*Ill. 79*

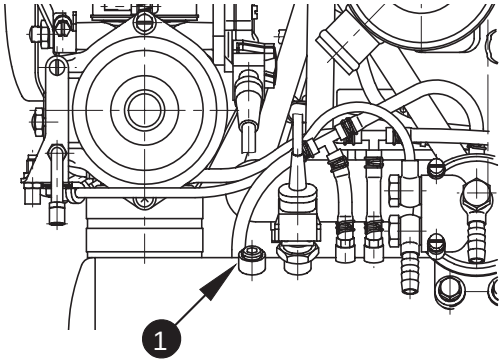
■ ATTENTION: Flawless operation of the indicating instrument needs the installations of a water trap between engine and instrument for the fuel condensate.

## 23.6) Air temperature in the airbox

See Ill. 80.

To take air temperature readings in the airbox a connection is provided. This connection is closed on the standard engine by a plug screw.

➪ connection: tapping 1/8-27 NPT
thread length approx. 9 mm (3/8")




*Ill. 80*

## 24) Preparations for trial run of engine

▲ WARNING: Prior to engine start and operation review all instructions stated in the Operator's Manual.

**Verification of the throttle lever detent for max. continuous power:**

Performance check in accordance with Operator's Manual.

If nominal performance won't be reached or is in excess of, examination of the installation and engine will be necessary. Consult Maintenance Manual 914 F.

■ ATTENTION: Don't conduct any test flights before fault has been traced and found.

## 25) ROTAX Authorized Distributors for Aircraft Engines

See current issue of Operator's Manual section 14 or in the Internet on the official website **www.rotax-aircraft-engines.com**.

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